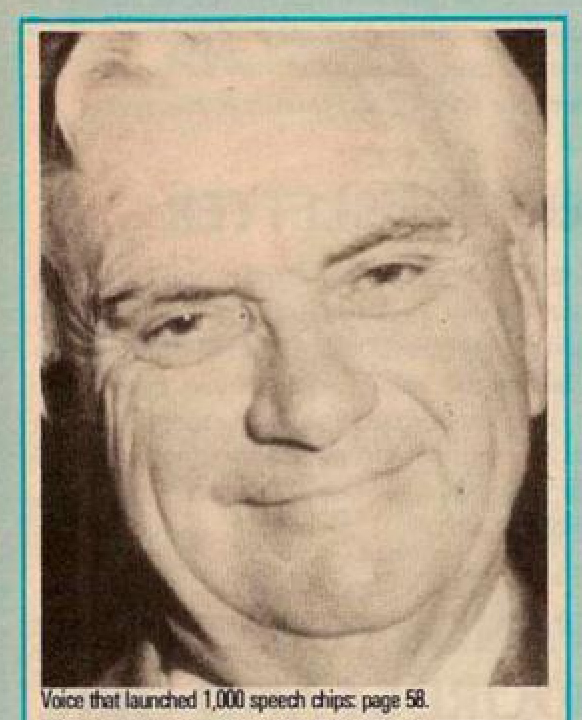
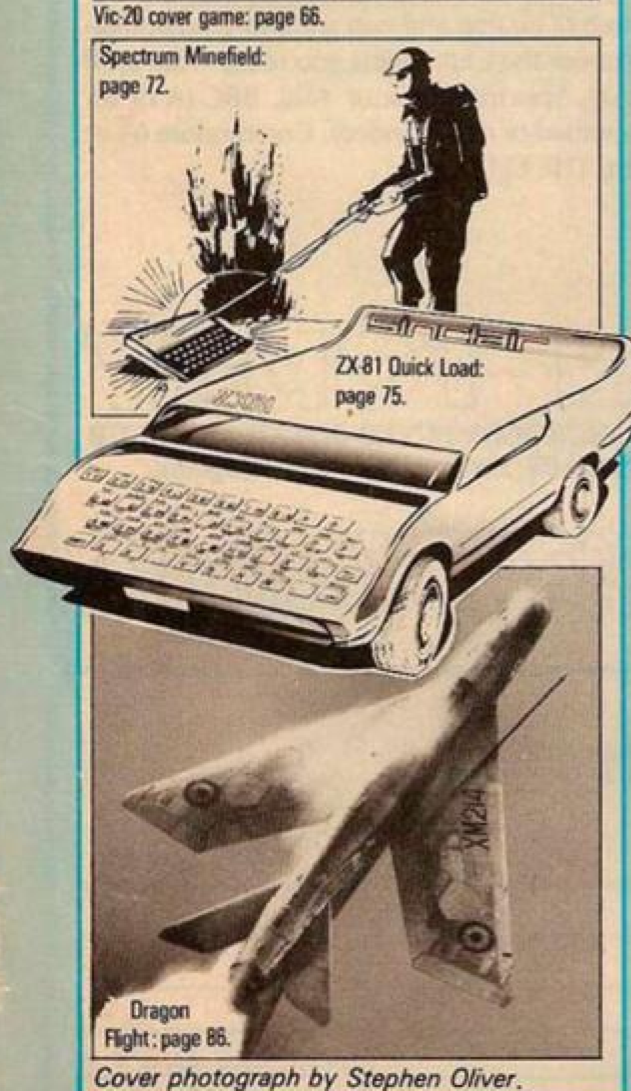

70p
The Computer Fair
£1 admission voucher inside
Denmark DKr 26.00
Germany Dm 6.50
Greece Dra 190.00
Holland DFL 6.50
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New Zealand NZ$ 2.60
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YOUR COMPUTER
JUNE 1983
BRITAIN'S BIGGEST-SELLING HOME COMPUTER MAGAZINE
Vol. 3 No. 6
Brave the corridor of fire in our Scram-20 Vic game
Reviews: BBC speech chips
Vic-20 software
Spectrum Minefield
Starting Oric graphics
Dragon flight simulator
ZX-81 quick loader and 1K wonders
MEMOTECH
Can Memotech change the shape of home micros?
We preview the Computer Fair launches
Win a Microline printer

YOUR COMPUTER Contents

JUNE 1983


Voice that launched 1,000 speech chips: page 58.


Vic-20 cover game: page 66.


Spectrum Minefield: page 72.
ZX-81 Quick Load: page 75.
Dragon Flight: page 86.

Cover photograph by Stephen Oliver.

WIN A MICROLINE PRINTER:

See card between page 42 and 43.

IMPORTANT NEWS FOR HOME COMPUTER OWNERS

Now you can have complete protection against breakdown after the expiry of your manufacturer's guarantee!



Here's good news for computer owners:
Now you can completely safeguard your equipment against repair costs through breakdown **after your manufacturer's guarantee has run out!**
And at very little cost.
It's called the COMPUTER-SAFE EXTENDED GUARANTEE PLAN, and has been organised by **COMPUTERS FOR ALL** to give complete 'peace of mind' during the second and future years of ownership!
Here's how it works:

Little cost. BIG cover

The costs depend on the purchase price of your computer . . . for instance:

Purchase Price	Up to £200	£201-£300	£301-£400	£401-£500	Over £500
COMPUTER PRINTER DISC or MONITOR	£15.00	£22.50	£30.00	£37.50	ASK!

For this you are covered for the cost of repair following mechanical or electrical breakdown* **or** the market value if the cost of repair exceeds the value of the equipment at the time of breakdown, with a maximum amount of £1,000 payable in any one period for insurance.

BIG cover. No quibble

With a COMPUTER-SAFE PLAN, you can arrange for the repair through either your local COMPUTERS FOR ALL Dealer who will claim the costs from us, or you can use any bona-fide computer repair company providing you first settle the account and then reclaim your costs from Domestic & General Insurance Co. Ltd.
There's no quibble. No sending through the mail. With a COMPUTERS FOR ALL Dealer you will get fast, efficient and professional service!

You're covered from day one!

With a COMPUTER-SAFE PLAN you're covered from the expiry date of your manufacturer's guarantee on all products. it will be effective for a whole **12 months** from that date. Thereafter you will be invited to renew the policy for a further period!

Choose the equipment you want to cover

Apart from your Home Computer, you can also have a COMPUTER-SAFE PLAN to cover peripheral equipment such as Printers, Monitors, Disc Drives etc. The costs being those already quoted for computers.

DO IT NOW AND GET AN INCREDIBLE INTRODUCTORY OFFER!

Normally in order to be eligible for this extended guarantee you have to apply within 30 days of purchase of equipment, but as an introduction to the COMPUTER-SAFE PLAN we are offering a SPECIAL AMNESTY for existing owners.
If you bought a computer (or equipment) between June 1st 1982 and May 31st 1983, you can purchase a COMPUTER-SAFE GUARANTEE and get full cover for a whole year!
This is the **only** time this offer will be made so **SEND IMMEDIATELY!**



COMPUTER-SAFE EXTENDED GUARANTEE PLAN

(Please complete in block capitals)
SURNAME ____
Mr/Mrs/Miss ____ Initials ____
Address ____
____
____
Equipment details: Type and Make
____
Model No. ____ Serial No. ____
Tube Size and Serial No. (if applicable) ____
Period of manufacturer's guarantee/years ____
Purchase price £ ____

Purchase date ____
Payment enclosed £ ____
Declaration
I hereby apply for your breakdown Insurance in accordance with the terms of your Policy, of which I understand a specimen is available on request, issued in respect of this class of insurance. I warrant that the equipment is in good working order and used for domestic purposes only and declare that the details in this proposal are true and complete to the best of my knowledge and belief. I agree that this declaration shall be the basis of the contract between myself and the Domestic & General Insurance Co. Limited.
Signed ____
Date ____

Please enclose the following with this application:
Proof of purchase of machine(s) either original receipt, guarantee card or other substantiation.
Remittance in full (see schedule above). Cheques made payable to: **Domestic & Genreal Insurance Co. Ltd.**

*Please note: the policy does not cover overhaul, modification, repairs to finish or cosmetic trim, damage caused by wilful act or neglect, loss or damage arising out of commercial use, or loss of the insured product or consequential loss of any kind.
The completion of this form does not constitute a contract — insurance will be issued at the sole discretion of Domestic & General Insurance Co. Ltd.

Post Today to:
COMPUTERS FOR ALL,
72 North Street, Romford, Essex.

The June Top Ten in Spectrum software at W. H. Smith.



Flight Simulation
Sinclair 48K £7.95



Penetrator
Melbourne House
48K £6.95

The range of software available for the Sinclair Spectrum is to say the least, extensive.

So every month at W. H. Smith, we review the range with particular reference to presentation, challenge, excitement and value for money. And because we're quite severe it's a difficult job finally to arrive at a Top Ten. But as you can see, not impossible.

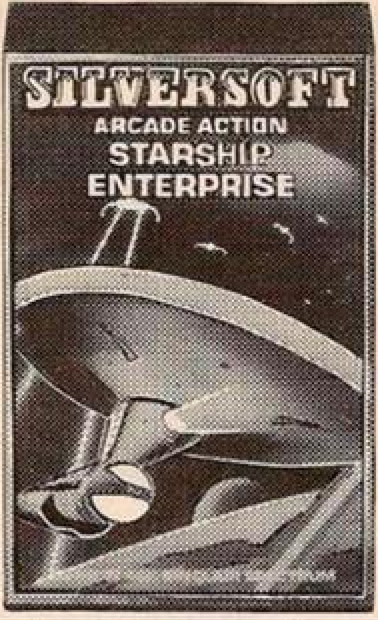
You don't have to take our word for it.

At W. H. Smith we stock the widest selection of Spectrum Software, so you can judge for yourself.

Title	Producer	K RAM	Price
Arcade Games			
Meteor Storm	Quicksilva	16	£4.95
Space Intruders	Quicksilva	16	£4.95
Time Gate	Quicksilva	48	£6.95
Gulpman	Campbell	16	£4.95
Spectral Invaders	Bug-Byte	16	£5.00
Meteoroids	Softek	16	£4.95
Planetoids	Sinclair	16	£4.95
Hungry Horace	Sinclair	16	£5.95
Space Raiders	Sinclair	16	£4.95
Mazeman	Abersoft	16	£4.95
Nightflight	Hewson	48	£5.95
Ground Force Zero	Titan	16	£5.00
Caterpillar	CDS	16	£5.95
Leapfrog	CDS	16	£5.95
Gobble-A-Ghost	CDS	16	£5.95
Centi-Bug	DK Tronics	16	£4.95
3D Tanx	DK Tronics	16	£4.95
Cruising	Sunshine	16	£4.95
Blind Alley	Sunshine	16	£4.95
Derby Day	Computer Rentals	48	£5.95
Jackpot	Computer Rentals	48	£4.95
Escape	New Generation	16	£4.95
3D Tunnel	New Generation	16	£5.95
Gobbleman	Artic	16	£4.95
Galaxians	Artic	16	£4.95
Invasion Force	Artic	16	£4.95
Sentinal	Abacus	16	£4.95



Chess
Sinclair
48K **£7.95**



Starship Enterprise
Silversoft
48K **£5.95**



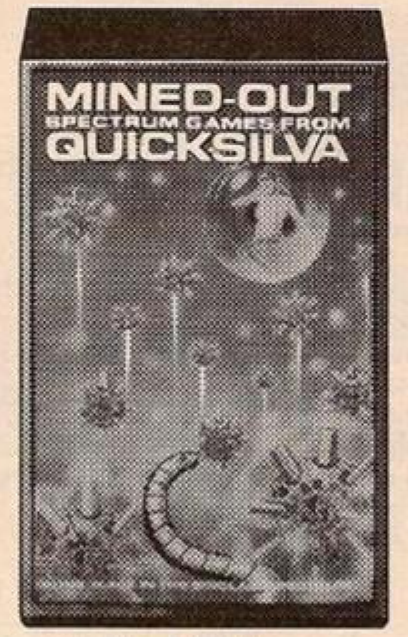
Horace Goes Skiing
Sinclair
16K **£5.95**



Schizoids
Imagine
16K **£5.50**



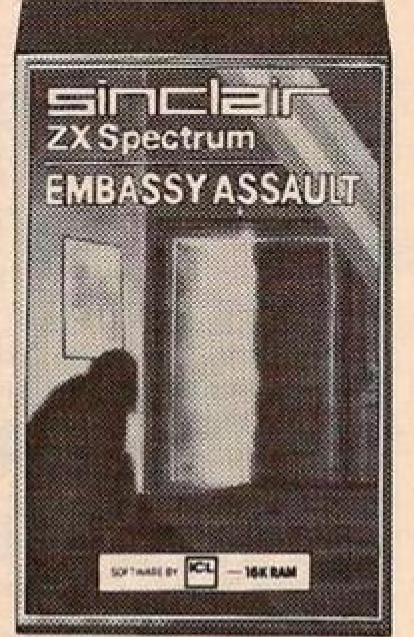
Muncher
Silversoft
16K **£5.95**



Mined-Out
Quicksilva
48K **£4.95**



Transylvanian Tower
Shepherd
48K **£6.50**



Embassy Assault
Sinclair
48K **£4.95**

Title	Producer	K RAM	Price
Avenger	Abacus	16	£4.95
Cyber Rats	Silversoft	16	£5.95
Arcadia	Imagine	16	£5.50
Ground Attack	Silversoft	16	£5.95
Orbiter	Silversoft	16	£5.95
Slippery Sid	Silversoft	16	£5.95
Strategy Games			
Battle of Britain	Microgame	48	£5.95
Novotnik Puzzle	Phipps	16	£4.95
Chess	Artic	48	£9.45
Voice Chess	Artic	48	£9.95
Superchess II	C P Software	48	£7.95
Football Manager	Addictive	48	£6.95
Chess - The Turk	Oxford	48	£8.95
Dictator	DK Tronics	48	£4.95
Everest Ascent	Shepherd	48	£6.50
Dallas	CCS	48	£5.95
Adventure			
Labyrinth	Axis	16	£5.95

Title	Producer	K RAM	Price
Planet of Death	Sinclair	16	£6.95
Inca Curse	Sinclair	48	£6.95
The Hobbit	Sinclair	48	£14.95
Ship of Doom	Artic	48	£6.95
Espionage Island	Artic	48	£6.95
Rescue	Computer Rentals	48	£5.95
The Orb	Computer Rentals	48	£5.95
Utility			
M/C Code Test Tool	Oxford	16	£9.95
Editor/Assembler	Oxford	16	£9.95
Compiler	Softek	16	£14.95
Soft Talk II	C P Software	48	£6.95
Spectsound	PDQ	16	£5.95
Family Games			
Reversi	Sinclair	16	£7.95
Othello	CDS	16	£5.95
Golf	R and R	16	£3.75
Conflict	Martech	48	£11.95
Test Match	Computer Rentals	48	£5.95

Title	Producer	K RAM	Price
Backgammon	C P Software	48	£5.95
Draughts	C P Software	48	£6.95
Practical			
Vu-Calc	Sinclair	16	£8.95
Vu-File	Sinclair	16	£8.95
Vu-3D	Sinclair	48	£9.95
Collectors Pack	Sinclair	48	£9.95
Club Record Controller	Sinclair	48	£9.95
Address Manager	Oxford	16	£8.95
Finance Manager	Oxford	16	£8.95
Dietron	Custom Data	16	£4.75
Program Collections			
Shiva Special 1	Shiva	16	£5.95
Over The Spectrum 1	Melbourne House	16	£5.95
Over The Spectrum 2	Melbourne House	16	£5.95
Over The Spectrum 3	Melbourne House	16	£5.95





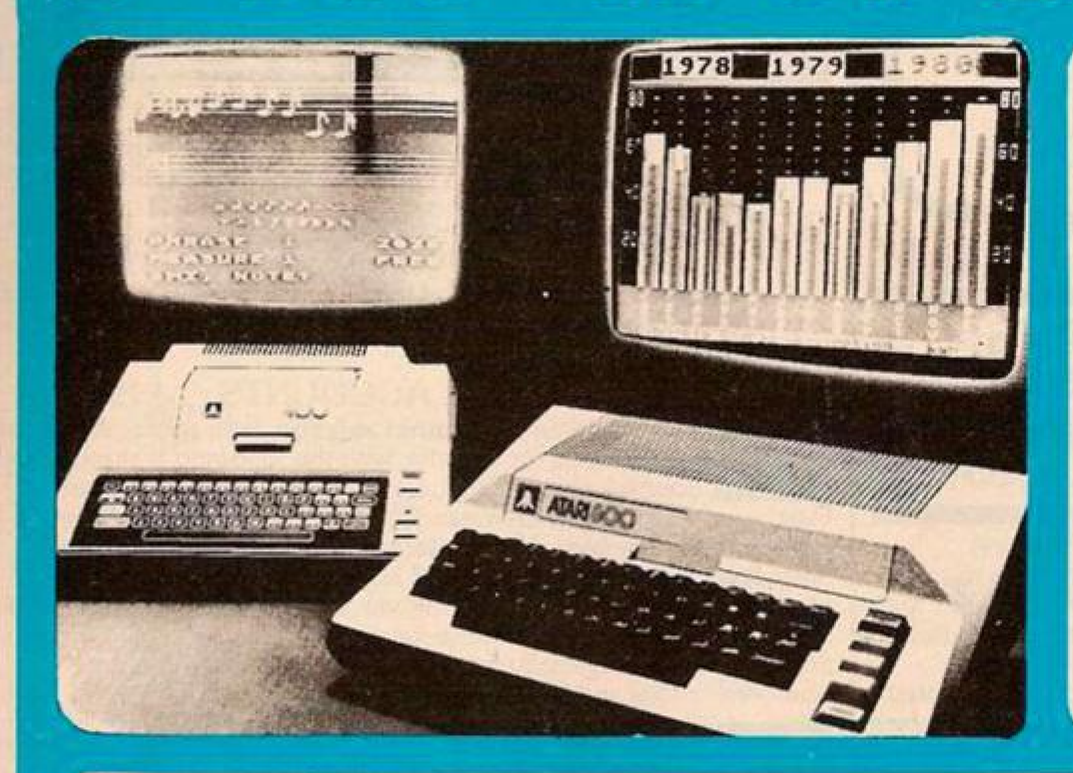
Prices correct at time of going to press. Subject to availability. At selected branches only.

100 FREE PROGRAMS

FROM SILICA SHOP — WITH EVERY PURCHASE OF AN

ATARI 400 800

ATARI



REDUCED PRICES!

We at Silica Shop are pleased to announce some fantastic reductions in the prices of the Atari 400 800 personal computers. We believe that the Atari at its new price will become the U.K.'s most popular personal computer and have therefore set up the Silica Atari Users Club. This club already has a library of over 500 programs and with your purchase of a 400 or 800 computer we will give you the first 100 free of charge. There are also over 350 professionally written games and utility programs, some are listed below. Complete the reply coupon and we'll send you full details. Alternatively give us a ring on 01-301 1111 or 01-309 1111.

ATARI 400 with 16K	**£159**
ATARI 400 with 48K	**£228**
ATARI 800 with 48K	**£349**

400/800 SOFTWARE & PERIPHERALS

Don't buy a T.V. game! Buy an Atari 400 personal computer and a game cartridge and that's all you'll need. Later on you can buy the Basic Programming cartridge (£35) and try your hand at programming using the easy to learn BASIC language. Or if you are interested in business applications, you can buy the Atari 800 + Disk Drive + Printer together with a selection of business packages.

Silica Shop have put together a full catalogue and price list giving details of all the peripherals as well as the extensive range of software that is now available for the Atari 400/800. The Atari is now one of the best supported personal computers. Send NOW for Silica Shop's catalogue and price list as well as details on our users club.

THE FOLLOWING IS JUST A SMALL SELECTION FROM THE RANGE OF ITEMS AVAILABLE:

ACCESSORIES
Cables
Cassettes
Diskettes
Joysticks
Le Stick - Joystick
Misc Supplies
Paddles

ADVENTURE INT
Scott Adams Adv
No 1 Adventureland
No 2 Pirate Adv
No 3 Mission Imp
No 4 Voodoo Cast
No 5 The Count
No 6 Strange Ody
No 7 Mystery Fun
No 8 Pyramid of D
No 9 Ghost Town
No 10 Sav Island 1
No 11 Sav Island 2
No 12 Golden Voy
Angle Worms
Deflections
Galactic Empire
Galactic Trader
Lunar Lander
Mountain Shoot
Rearguard
Star Flite
Sunday Golf

AUTOMATED SIMULATIONS
Crush Crumble Cmp
Datestones of Ryn
Dragons Eye
Invasion Orion
Rescue at Rigel
Ricochet
Star Warrior
Temple of Apshai
Upper Reaches Aps

BOOKS
Basic Ref Manual
Compute Atari DOS
Compute Bk Atari
Compute Magazine
De Re Atari
DOS Utilities List
DOS2 Manual
Misc Atari Books
Op System Listing
Wiley Manual

BUSINESS
Calculator
Database Managemt
Decision Maker
Graph-It
Invoicing
Librarian
Mort & Loan Anal
Nominal Ledger
Payroll
Personal Finl Mgmt
Purchase Ledger
Sales Ledger
Statistics 1
Stock Control
Telelink 1
Visicalc
Weekly Planner
Word Processor

CRYSTALWARE
Beneath The Pyram
Fantasyland 2041
Galactic Quest
House Of Usher
Sands Of Mars
Waterloo
World War III

DYNACOMP
Alpha Fighter
Chompelo
Crystals
Forest Fire
Intruder Alert
Monarch
Moonprobe
Moving Maze
Nominoes Jigsaw
Rings of The Emp
Space Tilt
Space Trap
Stud Poker
Triple Blockade

EDUCATION from APX
Algicalc
Atlas of Canada
Cubbyholes
Elementary Biology
Frogmaster
Hickory Dickory
Inst Comptg Dem
Lemonade
Letterman
Mapware
Maths-Tac-Toe
Metric & Prob Solvg
Mugwump
Music Terms/Notatn
Musical Computer
My First Alphabet
Number Blast
Polycalc
Presidents Of U.S.
Quiz Master
Starware
Stereo 3D Graphics
Three R Math Sys
Video Math Flash
Wordmaker

EDUCATION from ATARI
Conv French
Conv German
Conv Italian
Conv Spanish
Energy Czar
European C & Caps
Hangman
Invit To Prog 1/2/3
Kingdom
Music Composer
Scram
States & Capitals
Touch Typing

EMI SOFTWARE
British Heritage
Cribbage/Dominoes
Darts
European Scene Jig
Hickory Dickory
Humpty Dumpty
Jumbo Jet Lander
Snooker & Billiards
Submarine Commdr
Super Cubes & Tilt
Tournament Pool

ENTERTAINMENT from APX
Alien Egg
Anthill
Attank
Avalanche
Babel
Blackjack Casino
Block Buster
Block 'Em
Bumper Pool
Castle
Centurion
Checker King
Chinese Puzzle
Codecracker
Comedy Diskette
Dice Poker
Dog Daze
Domination
Downhill
Eastern Front
Galahad & Holy Grl
Graphics/Sound
Jax-O
Jukebox
Lookahead
Memory Match
Midas Touch
Minotaur
Outlaw/Howitzer
Preschool Games
Pro Bowling
Pushover
Rabbotz
Reversi II
Salmon Run
747 Landing Simul
Seven Card Stud
Sleazy Adventure
Solitaire
Space Chase
Space Trek
Sultans Palace
Tact Trek
Terry
Wizards Gold
Wizards Revenge

ENTERTAINMENT from ATARI
Asteroids
Basketball
Blackjack
Centipede
Chess
Entertainment Kit
Missile Command
Pac Man
Space Invaders
Star Raiders
Super Breakout
Video Easel

ON LINE SYSTEMS
Crossfire
Frogger
Jawbreaker
Mission Asteroid
Mouskattack
Threshold
Ulysses/Golden Fl
Wizard & Princess

PERIPHERALS
Centronics Printers
Disk Drive
Epsom Printers
Program Recorder
RS232 Interface
Thermal Printer
16K Memory RAM
32K Memory RAM

PERSONAL INT from APX
Adv Music System
Banner Generator
Blackjack Tutor
Going To The Dogs
Keyboard Organ
Morse Code Tutor
Personal Fitness Prg
Player Piano
Sketchpad

PROGRAMMING AIDS from Atari
Assembler Editor
Dsembler (APX)
Microsoft Basic
Pascal (APX)
Pilot (Consumer)
Pilot (Educator)
Programming Kit

SANTA CRUZ
Basics of Animation
Bobs Business
Display Lists
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Kids 1 & 2
Horizontal Scrolling
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Mini Word Processor
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Sounds
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- PART EXCHANGE SECOND HAND MACHINES — we offer a part exchange scheme to trade in many makes of T.V. game for personal computers.
- COMPETITIVE PRICES — our prices, offers and service are very competitive. We are never knowingly undersold, and will normally match any lower price quoted by our competitors.
- HELPFUL ADVICE — available on the suitability of various computers.
- AFTER SALES SERVICE — available on all computers out of guarantee.
- VAT — all prices quoted above include VAT at 15%.
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SILICA SHOP LIMITED
Dept. YC0683, 1-4 The Mews, Hatherley Road, Sidcup, Kent DA14 4DX. Telephone 01-301 1111 or 01-309 1111.



FREE LITERATURE

I am interested in purchasing an Atari 400/800 computer and would like to receive copies of your brochures and test reports as well as your price list covering all of the available Hardware and Software:

Name..

Address..

....

....

Postcode...

YC0683 — Your Computer — June 1983

Gemini more progra

GEMINI SPECIAL FREE OFFERS
3 for the price of 2 – SAVE £19.95!
5 for the price of 3 – SAVE £39.90!
7 for the price of 4 – SAVE £59.85!
(CASHBOOK & FINAL ACCOUNTS NOT INCLUDED)



CASH BOOK ACCOUNTS PROGRAM FOR BBC 32K, TORCH, SPECTRUM 48K
NEW..................£59.95

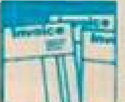
One of the most innovative business programs on the market. Replaces a manual cash book system, e.g. Simplex and 'All-in-One'. Written by practising Chartered Accountants, this practical program is simple to use and will replace your manual cash and bank records. By giving you access to vital management information as and when you want it, it will enable you to keep more positive financial control of your business.
The software is extremely well and lucidly documented, and Gemini provide a full technical back-up and product up-date policy. Take a look at the information this program will provide:-
• Summary of VAT information for VAT returns • Cumulative receipts and payments report analysed over the standard profit and loss and balance sheet headings • Option for departmental analysis of sales and purchases • Audit trail printout of all transactions. • Journal routine for entering transfers between accounts and year end adjustment for debtors, creditors etc. • Trial balance at any interval • Interfaces to 'Final Accounts' program to produce balance sheet and trading and profit/loss account etc. • Spectrum version may be used with Sinclair OR 80 column printer.



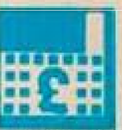
FINAL ACCOUNTS PROGRAM FOR BBC 32K, TORCH, SPECTRUM 48K.......£59.95
NEW

Requires Cash Book module. This program will take your cash book data to the logical conclusion of balance sheet, trading and profit/loss account and notes to the accounts i.e. fixed assets, land and buildings and capital accounts. Final accounts (BBC version) links to 'Beebplot' for graphic data presentation.
Format: Torch disk, BBC disk/cassette, Spectrum cassette.
Special Offer – Cash Book and Final Accounts together – £95

"Gemini's range of software is in the vanguard of the releases for 'serious' micro users..."
(WHICH MICRO AND SOFTWARE REVIEW)



INVOICES AND STATEMENTS...£19.95
Compatible with most micros. See table. Ideal for the small business. A complete suite of programs together with generated customer file for producing crisp and efficient business invoices and monthly statements on your line printer. All calculations include VAT automatically, and the program allows your own messages on the form produced. This program gives you superb presentation and saves time on one of the most tedious tasks in the office.

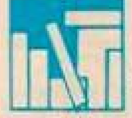


COMMERCIAL ACCOUNTS...£19.95
Compatible with most micros. See table. A gem of a program, all for cassette, with the following features:- Daily Journal. Credit Sales. Cash Sales. Credit Purchases. Purchases—other. Sales Ledger. Purchase Ledger. Bank Account. Year to date summary. A fully interactive program suitable for all businesses. Files can be saved and loaded and totals from one file carried forward to another on cassette. Particularly useful from a cash flow point of view, with an immediate accessibility to totals for debtors and creditors. Bank totally supported with entries for cheque numbers, credits and, of course, running balance.



MAILING LIST...£19.95
Compatible with most micros. See table. A superb dedicated database to allow for manipulations of names and addresses and other data. Gemini's unique 'searchkey' system gives you a further ten 'user-defined parameters' to make your own selections. Features include the facility to find a name or detail when only part of the detail is known, it will print labels in a variety of user specified formats.

DATABASE...£19.95
Compatible with most micros. See table. The program that everyone needs, the most valuable and versatile in your collection. Facilities include sort search, list print if required. Can be used in place of any card index application; once purchased you can write your own dedicated database to suit your particular needs with a limitless number of entries on separate cassettes.



STOCK CONTROL...£19.95
Compatible with most micros. See table. Dedicated software with all that's necessary to keep control of stock. This program will take the tedium out of stock control and save time and money. Routines include stock set up, user reference number, minimum stock level, financial summary, line print records, quick stock summary, add stock, delete/change record and more.



HOME ACCOUNTS...£19.95
Compatible with most micros. See table. Runs a complete home finance package for you with every facility necessary for keeping a track of regular and other expenses, bank account, mortgage, H.P., etc. This program also allows you to plot graphically by Histograms your monthly outgoings.



WORD PROCESSOR...£19.95
Compatible with most micros. See table. This program features routines found in much larger and more expensive packages with a typical word length of 5-6 letters it allows for around 1000 words in memory at one time. Ideal for the user who requires a simple program to write letters on his computer. Features include, block delete, block insert, search and replace, edit text, display text and more.

"Simple to use ...."
"Ideally suited to the way most offices run....."
PERSONAL COMPUTER NEWS

ms for more computers!



SPREADSHEET ANALYSIS BEEBCALC £19.95 DRAGONCALC £19.95

NEW

FOR BBC AND DRAGON 32. Spreadsheet processors have proved to be important tools for using micros in business, scientific and domestic financial applications.

	POSITION A1 RC	SPACE 5185	T
	II A II	B II	C II
1	– J.B. SNOOKER T/A POT – BLACK		
2	PROJECTED CASH FLOW	YEAR	ENDED
3			
4		Oct.	Nov.
5		£	£
6	INCOME		
7	Sales	11786	10944
8		———	———
9			
10	REVENUE EXPENDITURE		
11	Purchases	500	500
12	Advertising	500	1000
13	Director's salary	1596	1596
14	Salaries	2216	2216
15	Rent		
16	Telephone		300
17	Insurance		200
18	Printing, stationary		400
19	Repairs & renewals		
20	Hire of equipment	60	60
	COMMAND BCDEFGPRSTW'?		

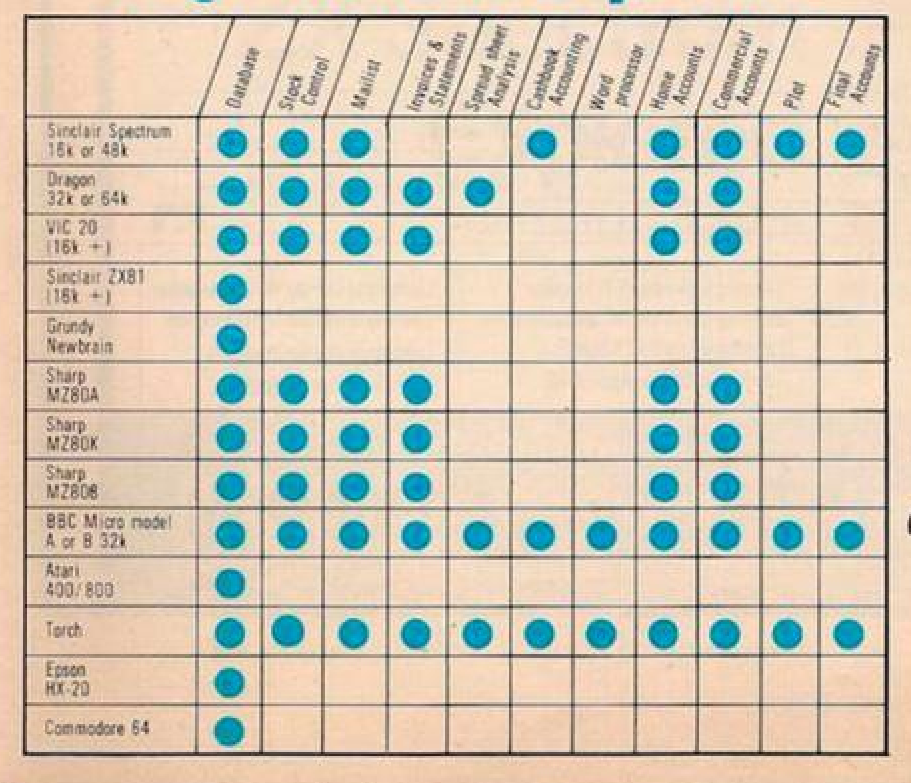
Without any programming knowledge at all, you may:-

- Set up a computerised spreadsheet, with chosen row and column names.
- Specify formulae relating any row or column to any other.
- Enter your source data and have the results calculated.
- Save the results on tape (or disk – BBC) for later reloading and manipulation.
- Print the tabulated results in an elegant report format.
- Experienced users may access saved files and write their own reporting or graphics presentation programs for the results.

Some typical applications: –

- Small business accounting applications, e.g. profit and loss statements and cashflow projections, break-even analyses etc.
- Investment project appraisal – anything from double glazing to oil rigs!
- Comparing rent/lease/buy options.
- Processing the results of scientific experiments or field studies.
- Engineering calculation models.
- In fact, anything that involves repeated re-calculation of results presented in tabular or spreadsheet format.

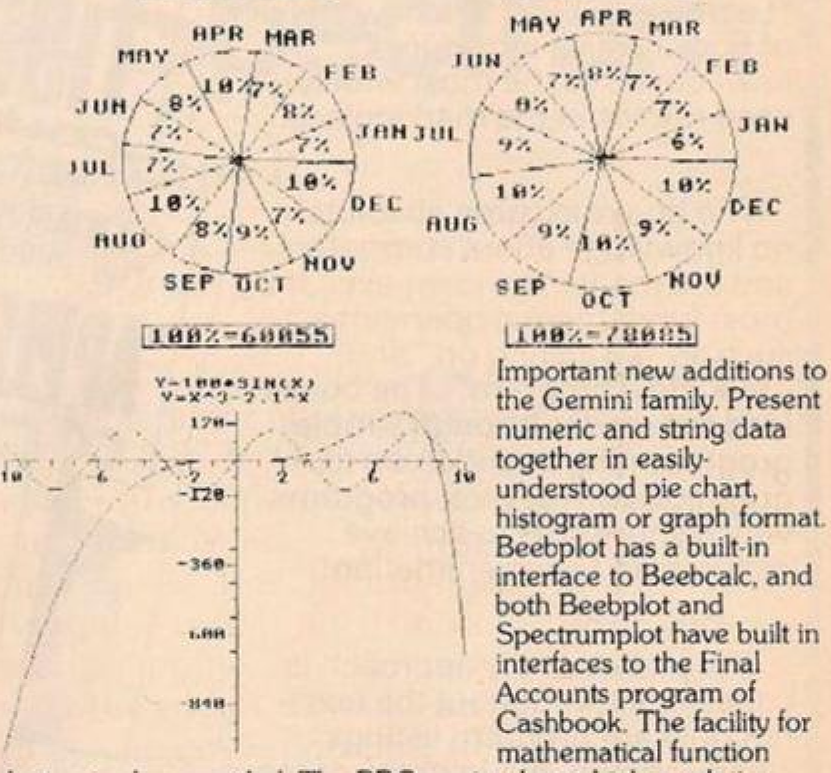
Program Availability Chart:-



	Database	Stock Control	Mailist	Invoices & Statements	Spread sheet Analysis	Cashbook Accounting	Word processor	Home Accounts	Commercial Accounts	Plot	Final Accounts
Sinclair Spectrum 16k or 48k	●	●	●			●		●	●	●	●
Dragon 32k or 64k	●	●	●	●	●			●	●		
VIC 20 (16k +)	●	●	●	●				●	●		
Sinclair ZX81 (16k +)	●										
Grundy Newbrain	●										
Sharp MZ80A	●	●	●	●				●	●		
Sharp MZ80K	●	●	●	●				●	●		
Sharp MZ80B	●	●	●	●				●	●		
BBC Micro model A or B 32k	●	●	●	●	●	●	●	●	●	●	●
Atari 400/800	●										
Torch	●	●	●	●	●	●	●	●	●	●	●
Epson HX-20	●										
Commodore 64	●										

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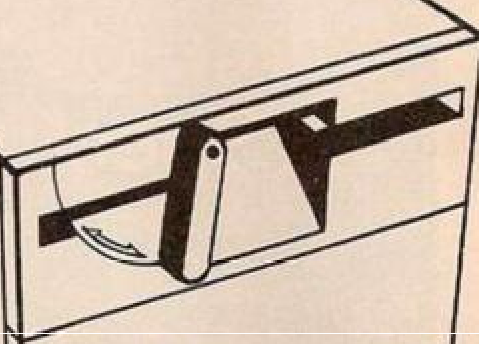
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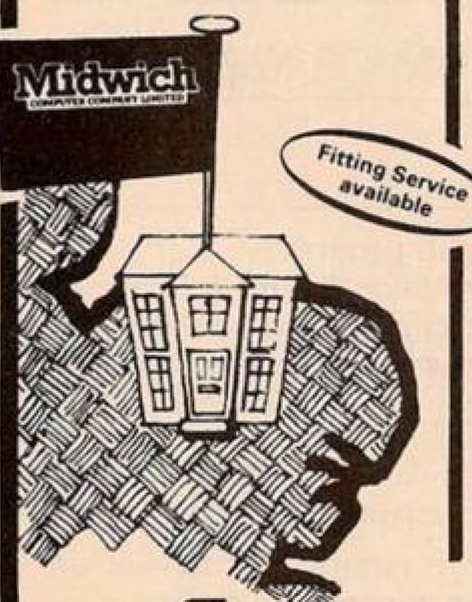


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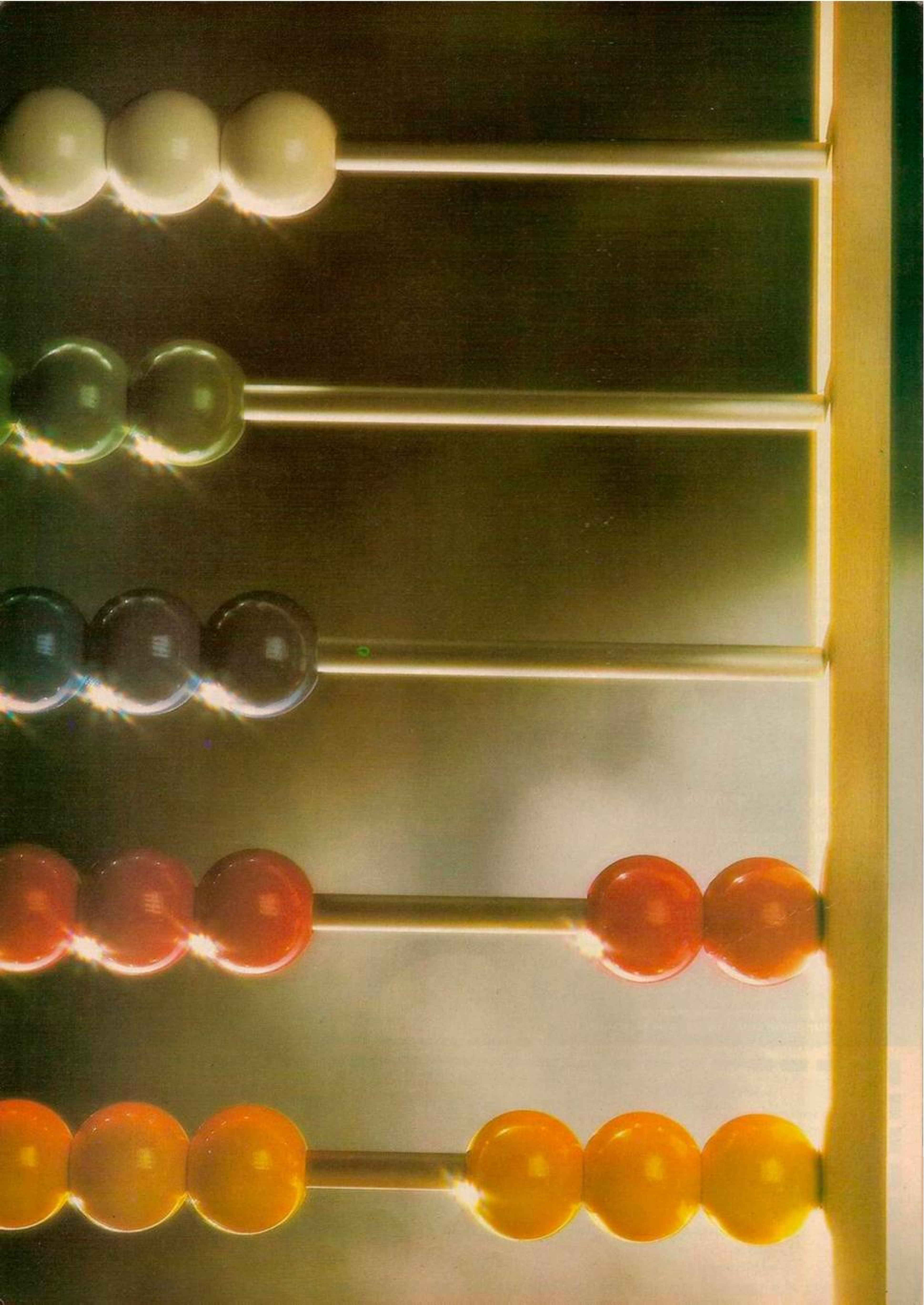
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As you can see, the Dragon offers real power and advanced features. It costs just £199.50* which you'll find represents real value for money. And unlike some competitors, it offers a professional-quality keyboard with real keys - guaranteed for 20 million depressions.

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As part of the current government subsidised scheme aimed at introducing micros to schools, the Department of Industry undertook a survey of machines available and made recommendations to education authorities all over the country.

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Teachers and education authorities agreed, and today it represents over three-quarters of all micros being ordered for schools across the country under the DOI scheme.

<u>The BBC's choice too.</u>

In choosing a machine to put their name to for their massive Computer Literacy Project, the BBC had the same set of priorities as the DOI. The BBC Micro is now an integral part of that project, which includes books, software, courses and a number of major television series, one of which, "Making the Most of the Micro" is now being broadcast.

<u>All this for only £399.</u>

The BBC Micro is light and compact. It generates high resolution colour graphics, and is capable of synthesising music and speech using its own internal speaker. The keyboard uses a conventional layout and typewriter feel.

The most sophisticated version (called Model B) is available for only £399. (There is also a basic model available, the Model A, at £299.)

<u>Designed to grow.</u>

Last year the magazine "Which Micro?" said that the most attractive and exciting feature of the BBC Microcomputer was its 'enormous potential for expansion'.

This is indeed one of the features that sets it aside from the competition.

For example, as well as interface sockets to allow you to connect to a cassette recorder, and to your own television, you can also use video monitors, disc drives, printers (dot matrix and daisy wheel) and paddles for games or laboratory use.

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<u>The Tube. A unique feature.</u>

The Tube, which is unique to the BBC Micro, provides for the addition of a second processor via a high speed data channel. The possibilities are enormous. For example, the addition of a second

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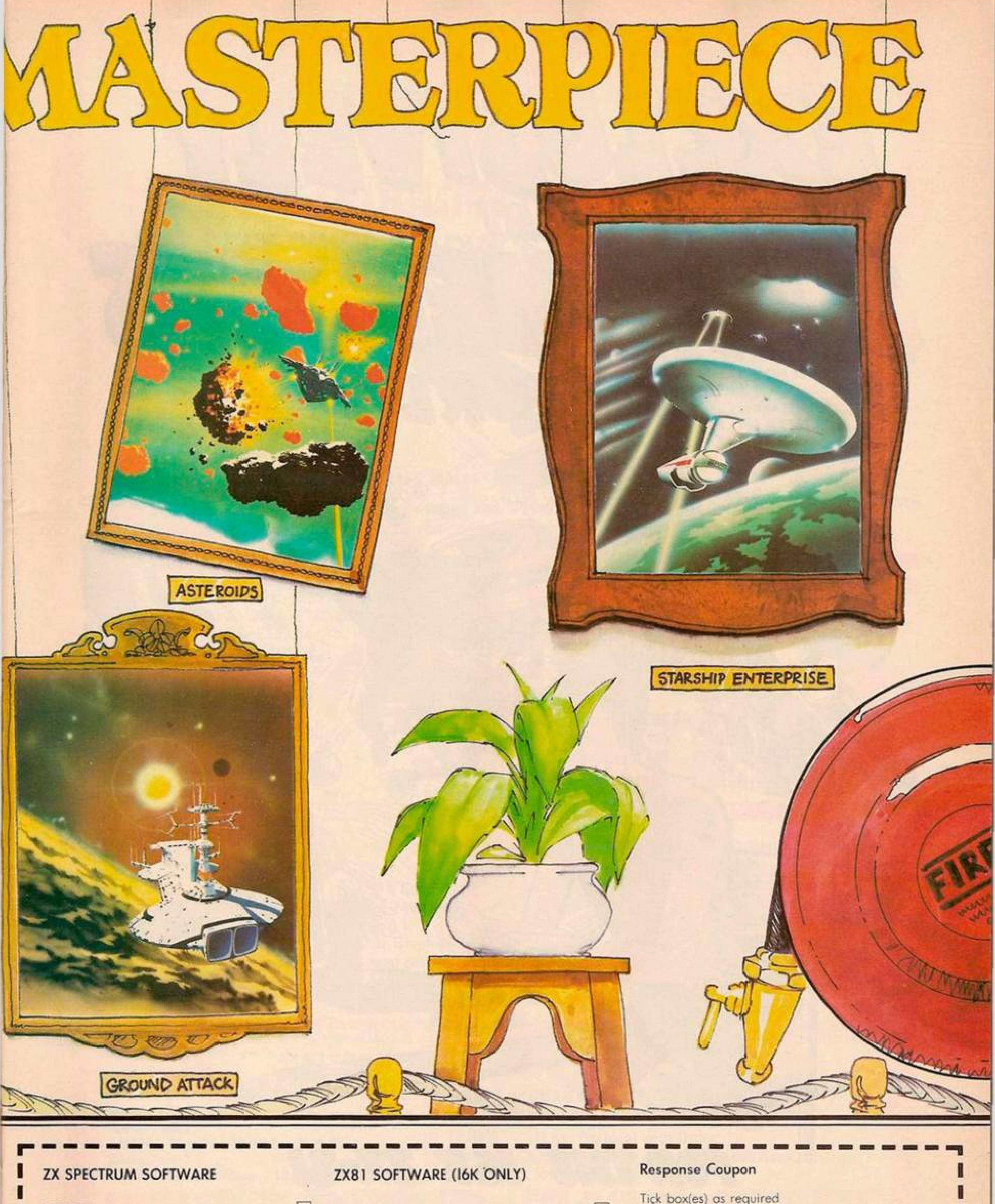
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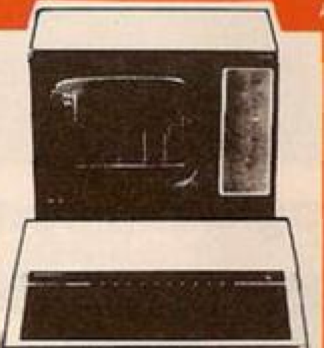
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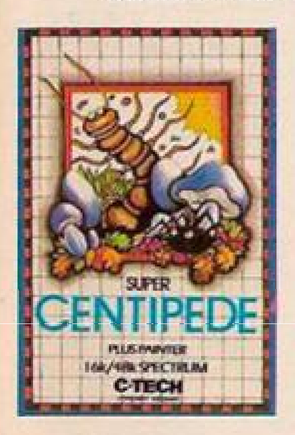
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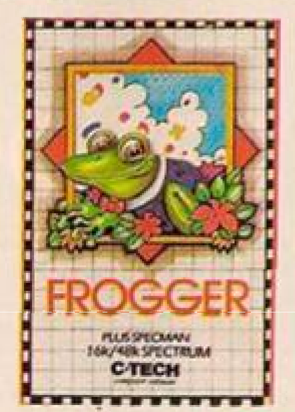
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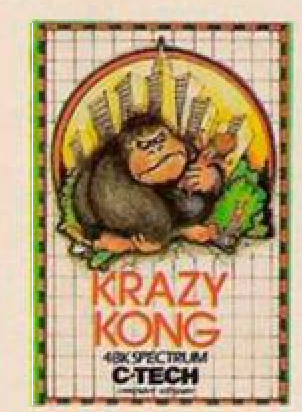
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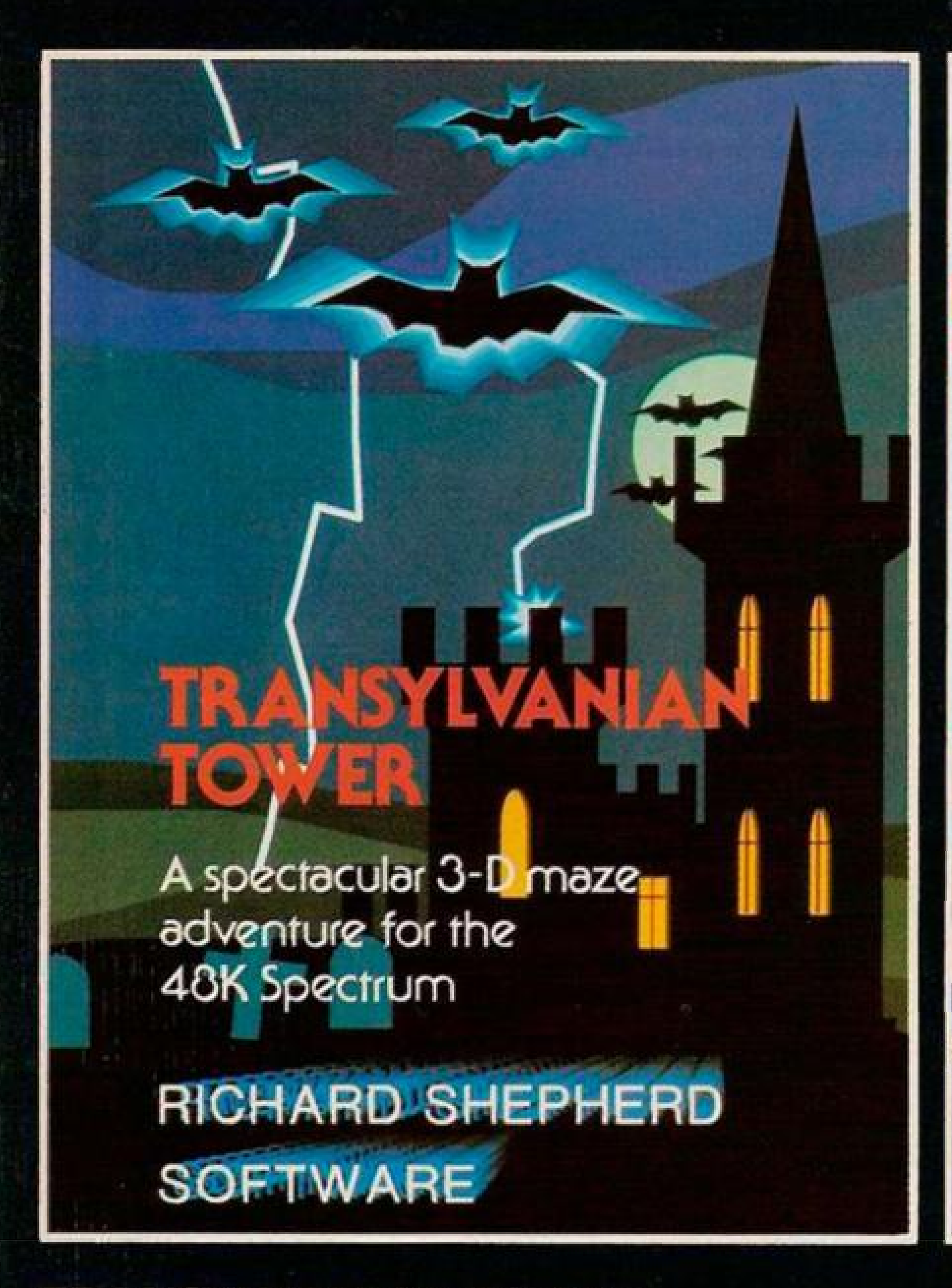
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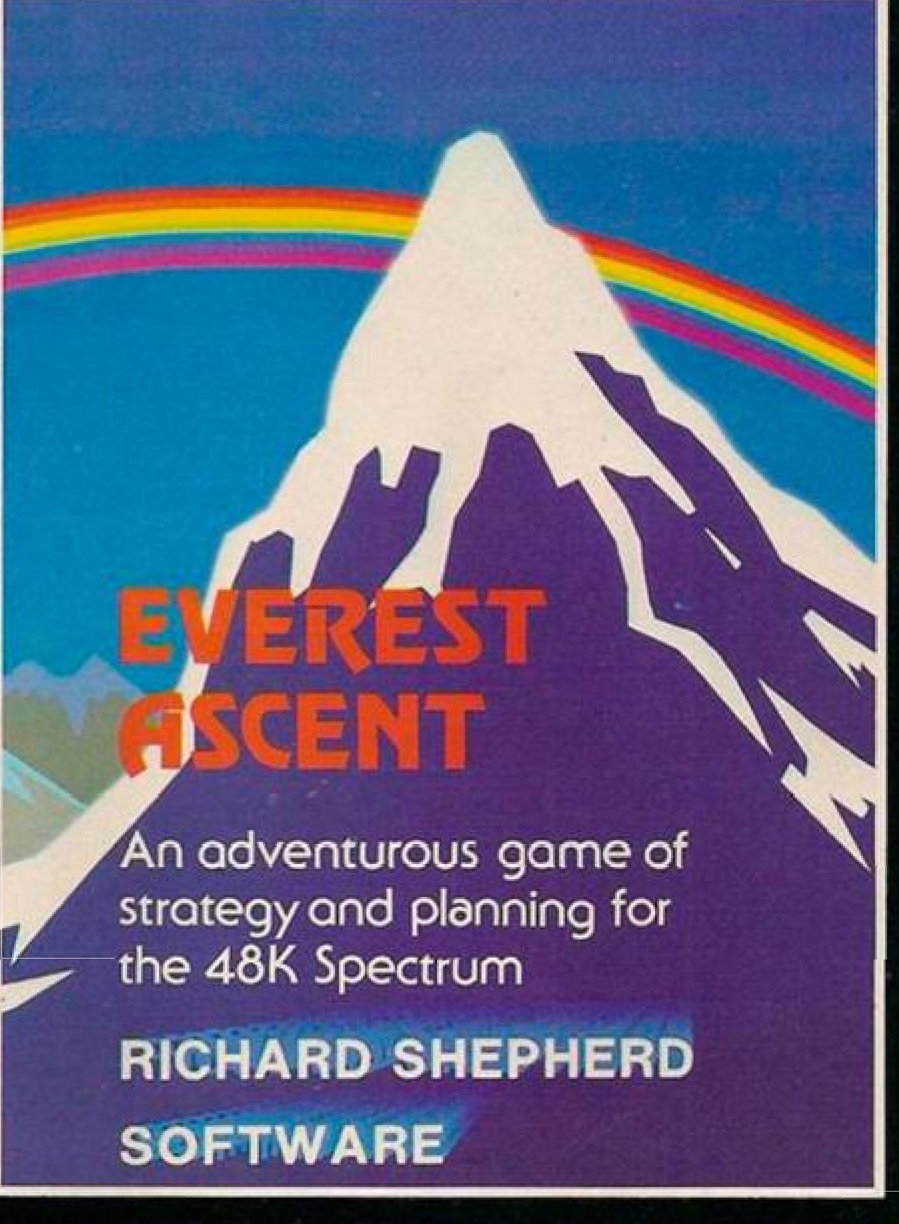
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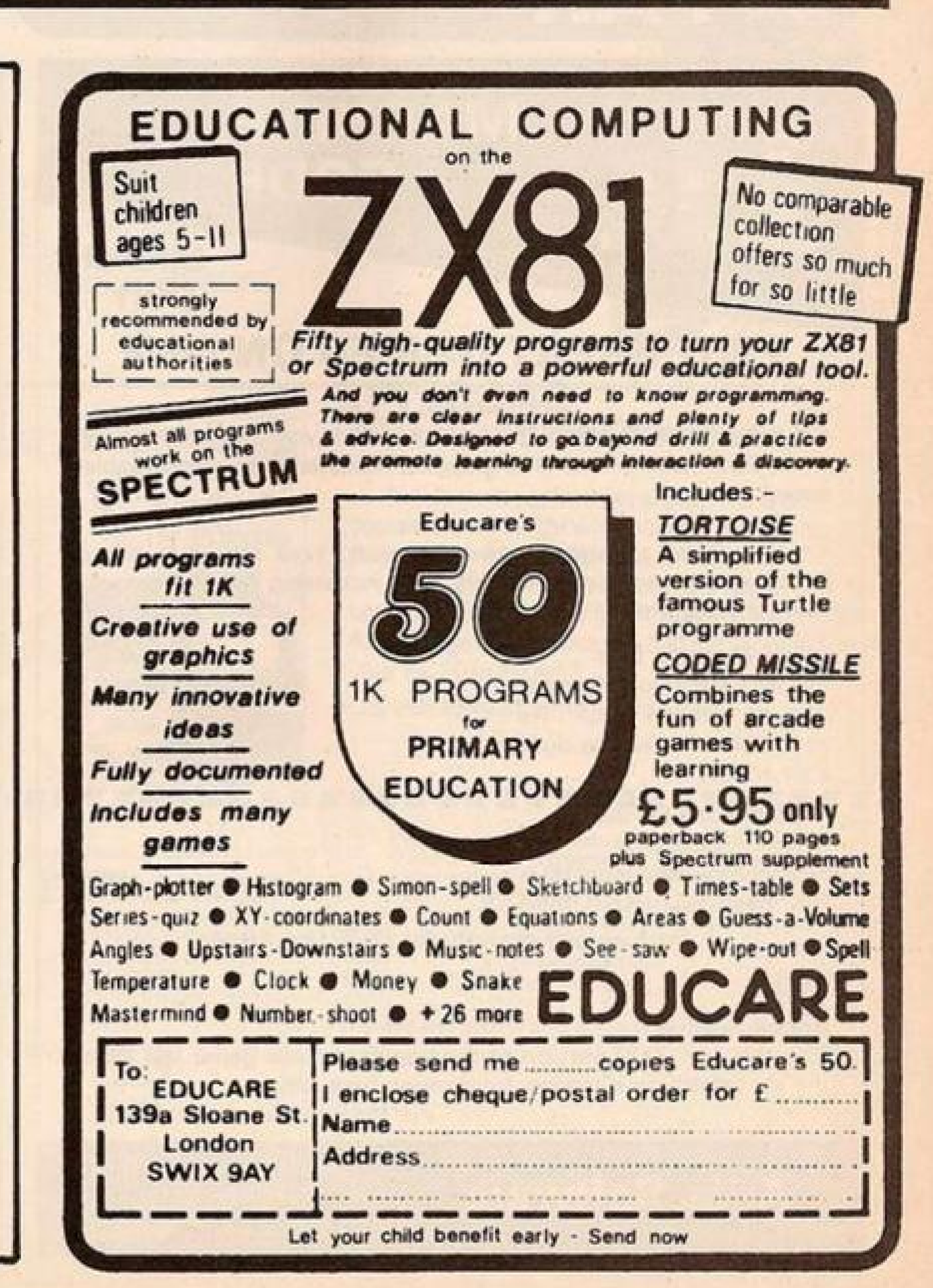
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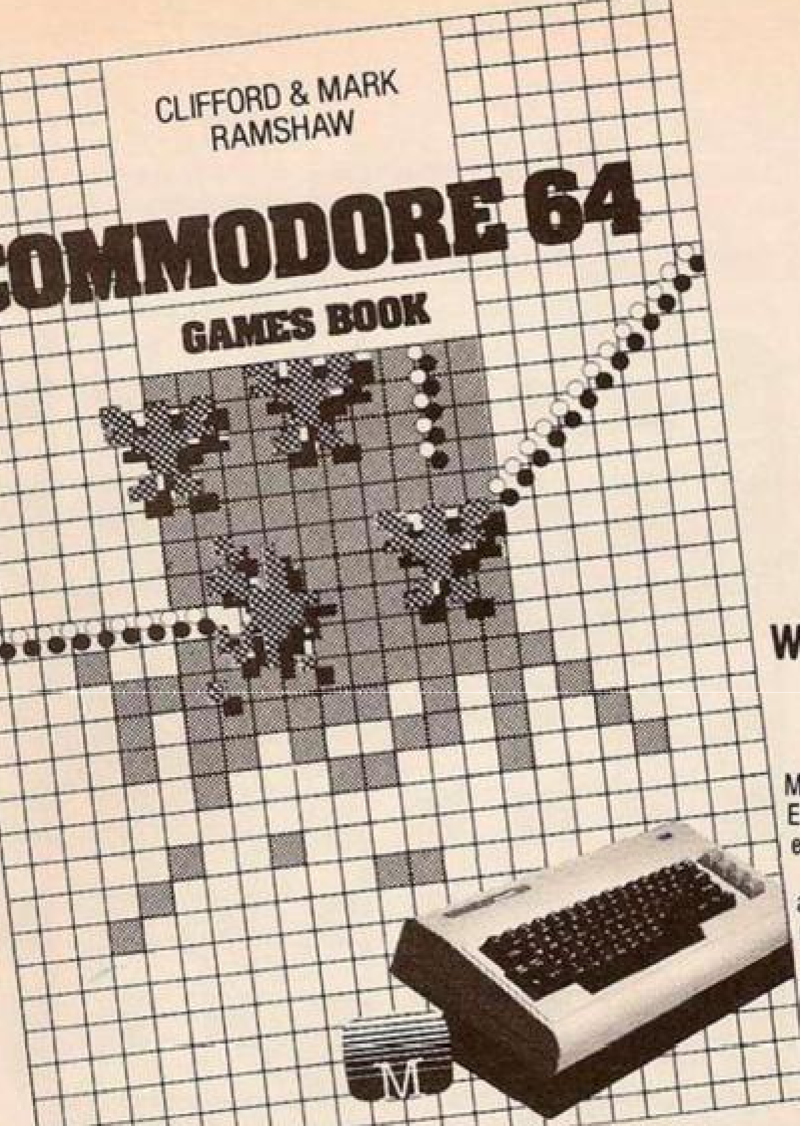
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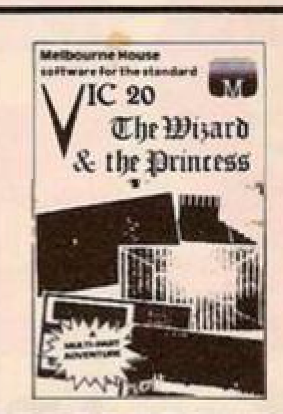


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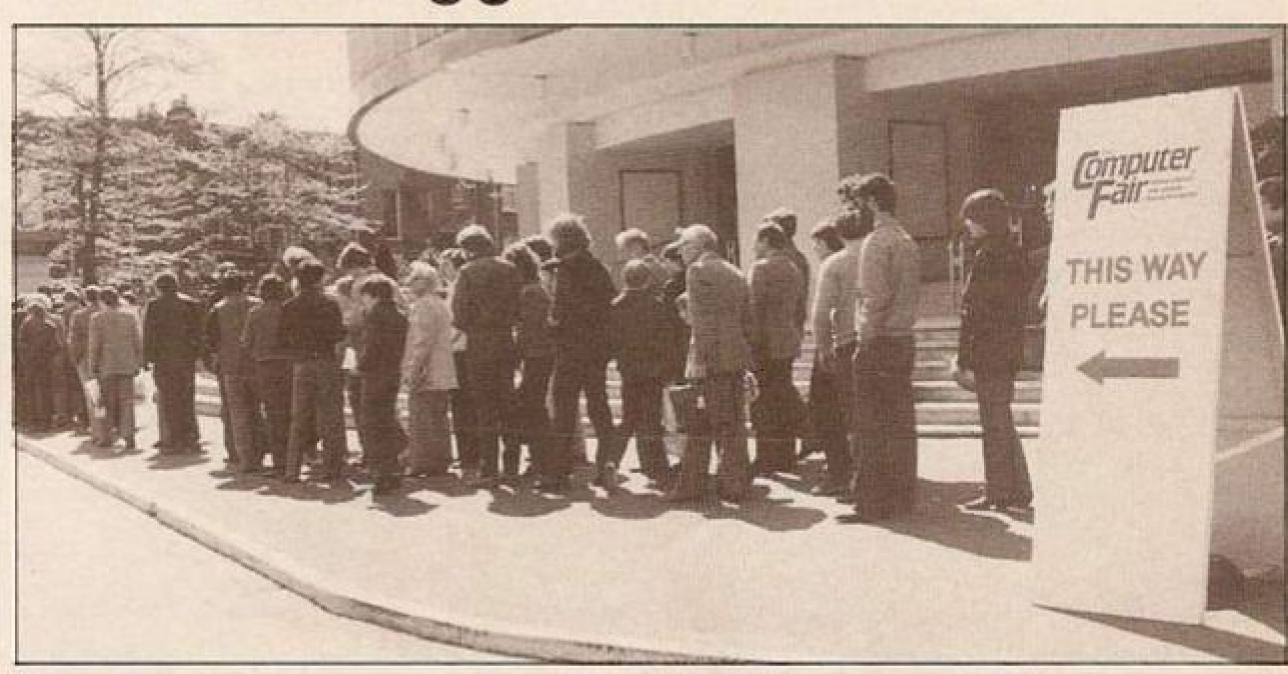

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Why 50,000 people are waiting for Britain's biggest-ever micro show



Relax — these are some of Computer Fair 82's 38,000 visitors — not the beginning of this year's queue.

EARLS COURT WILL be filled with the widest range of home micros and software ever seen in Britain when it hosts our Computer Fair later this month. Last year 38,000 computniks crowded into the fair — so this time we are providing three times as much space.

We will be taking the wraps off several new computers during the show including Memotech's MTX-500. Sinclair's new range of plug-in cartridge software for the Spectrum will be demonstrated in public for the first time. You will be able to hear Acorn's speech chip for the BBC Micro and decide for yourself whether it really does sound like Kenneth Kendall.

A new case for the Ace plus a range of peripherals will be on show from Jupiter Cantab. Camputers will be showing the elegant 48K Lynx but for the moment the company is keeping its lips sealed about the 96K version which its designers are working on.

Texas will be releasing details of the new TI-99/8 at the show and will be promoting the new £50 software package which is being included free with the TI-99/4A. Atari will be there too with the 400 and 800 home computers.

Oric will be at the show with the 48K, and at last 16K, Oric 1 and a new range of software. Have a look at Commodore's new soap-shaped cassette recorder which will now be included in the cost of a Vic-20.

Many of the 250 stalls at the fair will be selling software from all the household names — Bug Byte, Imagine, Quicksilva, Artic, Silversoft and a hundred others. More than 1,000 different games will be on show for home computers.

Because the show is jointly sponsored by *Your Computer* and *Practical Computing** there will also be a considerable choice of serious software — from word processors to finance and accounting packages for all the popular micros.

Ready for gorillas, Micromouse, Club Avenue and Sinclair Village



Last year's Micromouse champion Alan Dibley watching his T3 robot win.

THE COMPUTER FAIR is not just big stands for mighty manufacturers. Look out for Club Avenue — where the major computer clubs are happy to give you advice. Sinclair Village gives you a chance to pick up all those little bits and pieces to make your ZX-81 or Spectrum complete.

The great spectacle of the fair — apart from the programmers who dress up in gorilla suits or *Star Wars* outfits to try to make you buy their programs — is Micromouse.

This is a robot race around a maze. The robots are usually part home computer and part Meccano. You soon find out why these tea-caddy sized automatons have earned names like T3 and Thumper as they try to blunder their way to the centre of the maze before their rivals.

The fastest Micromice on Friday 17 June and Saturday 18 June will qualify for the British final which will be held on the Sunday afternoon. Often the owners of the robots are as entertaining to watch as the little machines themselves. Many a Micromouse has been threatened with a rapid return to the scrapyard after it has failed to live up to the owner's expectations.

The stakes are high because the British winner will be sent with his or her Micromouse all-expenses paid to the international finals in Spain.

Man with a secret



LAST YEAR Clive Sinclair surprised everybody by announcing the world's cheapest colour computer — the Spectrum — at the first day of our Earl's Court Computer Fair. This year he has at least one surprise up his sleeve for us — but is he ready to reveal it?

THROTTLE CONTROL FOR VIC

This program, to run on any Vic-20 expanded or not, actually allows the user to choose the speed of his program. It adds difficulty levels to any Basic program and thus can give new life to an old game that you have mastered and forgotten, or can improve performance in a business program.

I recommend that the routine be placed at the start of a program — at the end of the instructions is usually a good place. In my program I have not spaced or placcd my wording, nor have I set screen and border colours nor even a character colour; you can do this to suit your own needs. Type in Program 1.

A breakdown of this program is as follows: lines 10-60 provide a menu; line 70 sets up the input and gives it the name MD; line 80 checks to see that MD is legal; line 90 prints an error message if it is not, then sends it back to the input. Line 100 is the heart of the program: it Pokes the value MD into the correct location to control the speed.

After running the program you will notice that the speed of the cursor has changed. Actually the cursor's speed is the inverse of what happens during the program. If you

POKE 37879,1

directly into the computer the cursor speeds up yet the program would slow and

POKE 37879,255

slows the cursor, yet speeds up the program. To return the cursor to its normal speed press Run/Stop and Restore.

But is faster always better? What if you have sound and music in your program? Sound will not be thrown out as it usually follows suit with movement in the program, so sound can be forgotten, but music has to be played at the correct speed or it will no longer sound like music. To correct this flaw we must, before playing any music, return the Vic to its normal speed. We do this by

POKE 37879,78

and after the music, we return to the chosen speed by

POKE 37879,MD

typed in after the music. See program 2.

This procedure can also be used to get a program to speed up during a game by a line like:

9999 IF SCORE 1000THEN MD=MD+20

but nothing is perfect, when you change the operating speed of your Vic the real time clock is no longer real time so you must decide between a time-keeper and speed.

Program 1. How Fast?

```
10 CLR:PRINT"00-32 SLOW"
20 PRINT"33-64 SLUGGISH"
30 PRINT"65-128 AVERAGE"
40 PRINT"129-192 FAST"
50 PRINT"193-255 VERY FAST"
60 PRINT:PRINT:PRINT:PRINT
70 INPUT"HOW FAST";MD
80 IFMD>0ANDMD<256THEN100
90 PRINT"CHOOSE AGAIN":GOTO70
100 POKE37879,MD
101 the rest of your program
```

Program 2.

```
100 POKE36878,15
115 POKE37879,78
120 FORL=250TO200
    STEP-2
130 POKE36876,L
135 FORM=1TO100
140 NEXTM
150 NEXTL
160 FORL=205TO250
    STEP2
170 POKE 36876,0
180 FORM=1TO100
190 NEXTM
200 NEXTL
210 POKE36878,L
215 POKE36876,0
220 POKE37879,MD
```

Martin Dunn, Johannesburg, South Africa.

STORK PROBLEM

I read with interest Tim Hartnell's reply in *Response Frame* March to C Browning's enquiry on how to differentiate between the 16 and 48K Spectrum. Out of curiosity I peeped into the back of my supposedly 48K Spectrum and then typed in

DIM A$ (40000)

as suggested. I got an out-of-memory report code. Fortunately I live not too far from Camberley and so personally returned the computer in exchange for a 48K. No apology was given and by the string of other people there it seems Sinclair distribution centre must spend more time answering complaints than distributing computers — perhaps this is why it took so long to get one. Although my replacement does not give an out-of-memory report and does run 48K programs, I still cannot find the circular brown object Tim Hartnell spoke of — perhaps he has an earlier model.

A E Straszewski,
Petersfield,
Hampshire.

CARTE BLANCHE

I recently wrote to the TV Licence Records office to enquire if it was necessary for me to obtain a licence for an unmodified colour television which was to be used only as a computer display unit. They sent me this reply:

"I confirm that a television licence is not required if you are only using your television set as a computer display unit. If you receive any outside broadcasts a licence will be required. Our records have been amended. I trust this clarifies the situation for you."

J A Shield,
Witham,
Essex.

EASY TO LOAD

As a regular reader of *Your Computer* since its first issue I am amazed at the number of letters from readers with loading ZX-81 problems. It seems to me a case of the blind leading the blind. There is really no problem. All that is required for successful 100 percent loading is a well-modulated tape free from noise clicks and dropouts, the correct signal level neither too weak nor too strong and, providing the tape head is correctly aligned, and free from dust, the program will load. Unwanted noise is usually either already recorded on the tape or is picked up from the mains by the cassette player. A number of letters point to the TV as the culprit. But in my opinion this is rare, any transformer, especially a power supply is a more likely suspect. Sinclair Research say the optimum peak voltage for the tape signal is two volts but must be between 1 & 2.5 volts. Too little voltage and the ZX-81 does not hear it. Too high a voltage, and clipping, harmonics and information degredation follows. To the problem. This brilliant little device will cure problems at a stroke. The silent lead-in part of the tape will show up as not being silent if the tape is too noisy to load: it indicates the optimum two-volt peak signal level is correct and it also indicates too high a signal level. It shows up badly modulated tapes and enables one to adjust the volume control for optimum conditions. If the tape is loadable you can load it. Unlike the meter-type loading aid which does not identify peak voltages but only one's an average and therefore virtually useless readings. It gives the correct peak signal level. I really despair that so many still suffer problems: I am surprised it has not been mentioned *Your Computer.*

T C Rowbotham,
Cumbria.

A BIT USEFUL

A useful command on the Sinclair Spectrum, but not available on the BBC, is the bit command which converts numbers from 0s and 1s binary. Here is a small procedure for the BBC which will do the job. The function

FNBIT (B%)

converts a number B% from binary 0s and 1s into decimal and is a simple example of recursive programming.

```
DEF FNBIT (B%)
IF B% MOD 10>1 THEN = 0
IF B% = B% MOD 2 THEN = B%
ELSE=FNBIT (B%DIV10)*2+B%MOD
2
```

Martin Glass,
Truro,
Cornwall.

ATARI BUG SAFARI

I own an Atari 800. Since I bought it I have discovered a number of bugs in the software. Some of those are documented by Atari, some come in a handout issued with the software, some can be found in the magazines, others I have never seen mentioned in print. I have recently found a number of quirks while developing a large Basic program with assembler routines; quirks which I shall investigate at a quieter time. I have therefore finally asked Atari whether they have a list of known bugs they can issue on request. I was told they have not. No-one expects mainframe levels of support from micro manufacturers and, in many cases, bugs cannot be fixed because they are in Rom. But I take the view that manufacturers should be at least prepared to tell their customers what is wrong. I can imagine all those novices out there finding their Atari Basic program from time to time being lost on deleting a line, or corrupted on amendment, and wondering what's hit them. If you and your readers are interested I am prepared to collate errors and quirks so that you could publish them, with additions on an occasional basis. If this catches on, could we start with Basic and Assembler — other readers, other software? Since this would not be a debugging service correspondence would not be entered into and bugs should be somewhat documented. Certainly I would try to reproduce the error, and would put them to Atari for comment before they are published. I am sure users of other machines have the same problems. Perhaps publicity will persuade the manufacturers to improve their services and even, who knows, actually fix the bugs.

David Andrew, London, E17 9ES.

UNIFILE FAN

Just a word of appreciation for David Lawrence's excellent ZX-81 Unifile program in the April issue, for which I have already found several useful applications.

I have come across only one bug, in connection with amending data, which I think is perhaps worth correcting.

In the 4K file version, amendments do not return the amended entry if the display search item is the item amended, or if an entry is amended after stepping along the file using Newline. Both these cases can easily be corrected by the insertion of one additional instruction:

```
955 LET S$ = Q$
```

In the 9K file version there is an additional problem, in that S$ has been used for moving blocks of data, when it is already in use as the search parameter. This again can easily be corrected by substituting, say, M$ for S$ in lines 1890, 1900, 1990 and 2000 only.

Nevertheless a most useful and versatile program for which many thanks indeed to David Lawrence.

John Cutting,
Hampton,
Middlesex.

TELETEXT

On page 154 of the new BBC User Guide it states that the function keys when pressed in conjunction with the shift key produce a teletext control code, but this feature is not available on the 0.1 version of the operating system, so I wrote this simple program. Type it in as listed and then run it. The function keys will now perform as listed on page 154 of the User Guide — without pressing the shift key. To test it, type in as a direct command

```
PRINT"XXDEMO"
```

where XX is just a single depression of f1 and f8. The result should be Demo flashing in red. These control codes only work in Mode 7. To save these keys on tape type

```
*SAVE"KEYS" 0B00 + 00FF
```

It is useful to note that after defining a set of functions for the user keys they can be saved in the previous manner and re-loaded at any time with

```
*LOAD"KEYS"
```

This leaves any program already in memory intact.

```
10 REM TELETEXT KEYS BY
   T.J.MATSELL
20 C=17
30 FOR K = &0B00 TO &0B09
40 ?K=C
50 C=C+1
60 NEXT
70 FOR K = &0B0A TO &0B11
80 ?K=C
90 NEXT
100 C=128
110 FOR K = &0B12 TO &0B1B
120 ?K=C
130 C=C+7
140 NEXT
```

Timothy Matsell,
Lincoln. ■

EDITORIAL

In the palaces of the pop industry even the razzmatazz cannot hide the fact that sales of records have been in decline since peaking in the late seventies. Meanwhile in another sector of the nation's economy business is on the up and up. A tidy £1 million per month is one estimate of the size of the U.K.'s market for ZX Spectrum software. Working out the value of the whole home computer software market is what has been producing out-of-range errors on the software houses' pocket calculators.

Given these two contrasting tales of gloom and boom you need not be an industry pundit to grasp why major record companies such as Virgin and K-tel are moving into the lucrative business of selling software. Virgin Records has launched Virgin Games, and K-tel attended the Midland Computer Fair with £1 million in its pocket to negotiate deals with the software makers.

Now that some of the music industry's marketing and distribution power has been turned on the software business, can we expect to see national software charts — and the hyping that goes with them — computer programmers as stars, and Jimmy Savile taking Top of the Software Pops towards its first 1,000 episodes?

The first impact will probably be far less glamorous than that. It could affect the way we buy software.

New records usually get their first exposure on the radio. But because most software is sold through mail order, the first you hear of the computer cassette you order is the dull thud as it lands on the door-mat. Of course you can return it if it is not quite what you wanted. But it would be much easier if you could try out and buy the program in a local shop.

The music companies have the distribution networks to put software in the shops. That development could spell the decline of the mail-order software business. The price for entry into the program market will soar if computer software decamps to the high street. At the moment it is possible to start selling a few programs of a reasonable quality with a mail-order advertisement in *Your Computer*. With the arrival of the big boys from the music industry TV campaigns advertising a range of software could become commonplace. Some argue that the upshot of all this will be fewer software houses in a year's time.

Until now the name of the software writer has not mattered much — each game is judged on its own merits. One major software house recently confided to *Your Computer* that it even deliberately omitted programmers' names from cassette covers. It was afraid that its writers would be poached by rival firms. If marketing and distributing computer programs starts to involve the techniques the music industry uses, the programmer could become more important in selling the product. Could we even see famous names in computing advertised as the authors of the latest software which have in fact been written by teams of skilled but anonymous session programmers?

Imagine turning on your television only to see a perfectly-manicured Clive Sinclair beaming through the soft focus as he sits at the keyboard of his white Spectrum. In true Richard Clayderman style a relaxed voice-over coaxes you to enter the World of Clive Sinclair — a game for every mood.

How to write for *Your Computer*

We called this magazine *Your Computer* precisely because we welcome your views, tips and hints and even your criticism of machines and software in general. If you would like to see your name in print, whether on a Software File program or a full-blooded article, here is how to go about it. Ideally, all articles should be typed double-spaced on one side only of uniform sheets of paper. If listings can be dumped directly from a printer — you can always use a friend's or user group's — this minimises the risk of error. In a perfect world a cassette would accompany the article. That considerably speeds up the checking process. Not only do you get to air your own discoveries and opinions, but we will even pay you for the privilege. We pay £35 per published page — that's as it appears in the magazine and includes illustrations.

Why not give it a try? You have nothing to lose but your postage.

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Chartbuster K-tel's million pound bid for home computer games

CHARTBUSTER K-tel is serenading the software houses to the tune of £1 million. That is how much the record company, renowned for its TV-advertised compilation albums, took to the Midland Computer Fair to sign up distribution deals.

The first program maker to succumb to K-tel's overtures is DK'tronics which won an order to supply £150,000's worth of software.

Virgin Games — the Virgin Records offshoot which is the other recent venture from music land into computer games — is buying up the copyrights to new programs. In contrast Adrian Moulds, K-tel's software manager prefers for the moment partnership agreements.



K-tel wants DK'tronics software, not its peripherals.

Companies like DK'tronics develop programs and keep the copyright while K-tel distributes the software through the vans that service the 5,000 outlets for its record business. With a distribution network on that scale it is clear that K-tel believes that future software industry battles will be won in the high street. "The phase of selling by mail order is almost over" says Moulds. He compares the excitement over computer games with the early days of pop music, but he does not expect ace programmers to become like pop stars because "software is not the personality, visual thing that music has become."

Nevertheless do not be surprised if you see a sophisicated TV campaign this Christmas extolling the virtues of K-tel's 20 greatest computer game hits. K-tel's attitude to TV advertising might also be applied to its view of the software market now. "It's not for amateurs" says Adrian Moulds. "The stakes are very high."

Micros of the world unite with Cyborg's software translator

THE SECRET FOLLOW-UP to Cyborg's all-micro disc drive will break down the barriers that stop software written for one micro running on another. The French company is developing hardware which will allow all machines with the same central processor unit, or CPU, to share software.

Cyborg's priority is a unit for the 6502 CPUs used by most micro-makers. By early next year you my be able to run Vic software on a BBC Micro or on an Oric. Later a Z-80 version will be produced for Sinclair owners.

Cyborg's crusade against the idiosyncrasies of home computing with a 760K disc drive that will work with all home micros. Jean Garutti, the man behind Cyborg, expects to sell 100,000 of these units a year, but adds that the figure could "increase explosively". The 5.25in. drive costs £250 and, at the change of a connector and the insertion of a floppy disc, will work with your machine.

That floppy disc holds a "grammar" which describes the micro to the drive's disc-operating system contained in a ULA. Details of the computer's pin-outs, I/O, ROM and RAM maps, and the areas of memory available are contained in the grammar. Grammar discs and cables for the ZX-81 and Oric have already been produced, and the Spectrum, BBC Micro and Atari will have theirs next month. Dragon, Vic-20, Commodore 64 and TI-99/A and Lynx owners will be able to use the single-sided, single-density drive by September. Each disc can hold 240 entries, and file names can be up to 18 characters long.

David's Sharp Welsh tongue

FORGET FORTH, Logo and Pascal, the language your micro really needs is Welsh. John Loverseed has just written a Welsh Basic for the Sharp MZ-80K and MZ-80A, and he has been amazed at the response from computer fiends in Wales. When, they want to know, will they be able to buy Welsh Basics for their Spectrums, ZX-81s, Vic-20s and Bridgend-built Dragons?

Many of the enquiries have come from bilingual schools which want to teach computing in Welsh on their BBC Micros. Unfortunately they may have to wait because Loverseed has taken advantage of a feature of the Sharp which is unusual for a home computer. Every time you use the MZ-80 you have to load in the Basic from tape to disc.

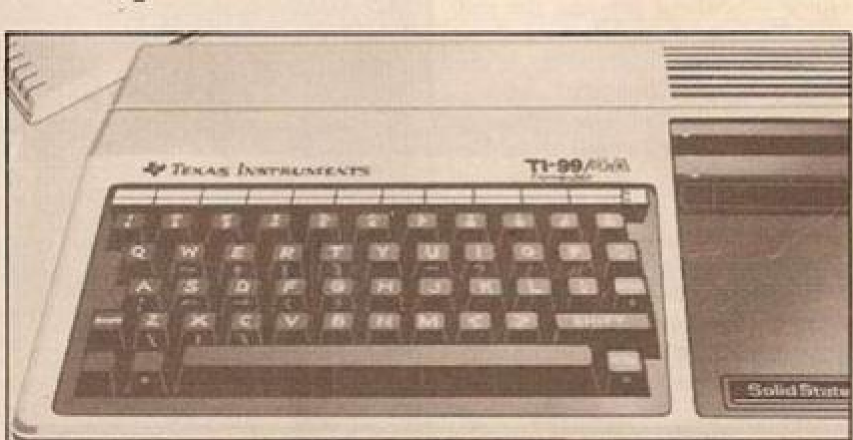
This can be a mixed blessing but it has made it very easy for Loverseed to adapt Sharp Basic and sell his Basic Cymraeg on tape. He has simply substituted Welsh words and abbreviations for the pseudo English of Basic. So, instead of Goto, Basic Cymraeg uses *Mynd* meaning "to go". It would be more difficult to implement Welsh versions for those home computers whose Basics are resident. Sharp Basic Cymraeg is available from David Computer Services 38 South Parade, Bramhall, Stockport, SK7 3BJ.

Texas TI-99/8 will offer 80K for £300 and can speak for itself

WITH 80K FOR £300 Texas Instruments new TI-99/8 is going to shake the micro market. *Your Computer's* American spies have already glimpsed the all-new 16-bit machine before its official launch. The TI-99/8 has built-in speech and can even read text out aloud.

The micro will have a high-resolution colour display and the kind of keyboard you would expect on a £1,000 machine. In addition to Basic, Forth and Logo, UCSD Pascal will be available soon after the TI-99/8 goes on sale in Britain in the late autumn.

The TI-99/8 will spearhead the new wave of Texas micros which has swept away the company's reputation as the slumbering giant of home computing. The CC-40 portable computer we reviewed in May is already selling well. TI-99/4A sales have taken off since the price was dropped to £150 and now Texas offers a £50 package including two joysticks a game cassette and an elementary Basic tutorial cartridge free with every TI-99/4A sold.



The TI-99/4A will be reskinned to look like the new TI-99/8.

Far from killing off the TI-99/4A, Texas is planning a reskin for the machine later in the year which will make it look more like the CC-40 and the forthcoming TI-99/8. Simplifying the internal design and better product engineering will allow Texas to reduce the price of the machine even further before Christmas. The £70 TI-99/2 black and white Basic tuition computer may now be upgraded before Texas launch it in September.



Mace — an assembler, editor and system monitor — sits at the top of RAM leaving enough room for a Basic program to be developed on the Dragon at the same time as machine code. It comes on a ROM cartridge and costs £29.95 from Windrush Micro Systems, Worstead Laboratories, North Walsham, Norfolk, and selected Dragon dealers.

Memotech MTX-500 understands Noddy

FRONT PANEL DISPLAYS like an Austin Maestro's dashboard, and a language called Noddy mark out Memotech's new 48K micro from the sub £300 crowd. Sprites and 16 colours in high-resolution are also part of the attraction.

Until now Memotech has concentrated on selling peripherals for the ZX-81. So it is no surprise that like the Sinclair the new micro — the MTX-500 — will be Z-80A based. Memotech will demonstrate the MTX-500 at our June Computer Fair and production will begin in August.

The new micro has a solid black aluminium case with a full 79-key keyboard including a numeric keypad and eight function keys. 16K of Rom will include Basic, an assembler and a disassembler. 32K of RAM will be available to the user and there will be alternative languages such as Logo, Forth and Pascal together with Noddy — a new language aimed at schoolchildren.

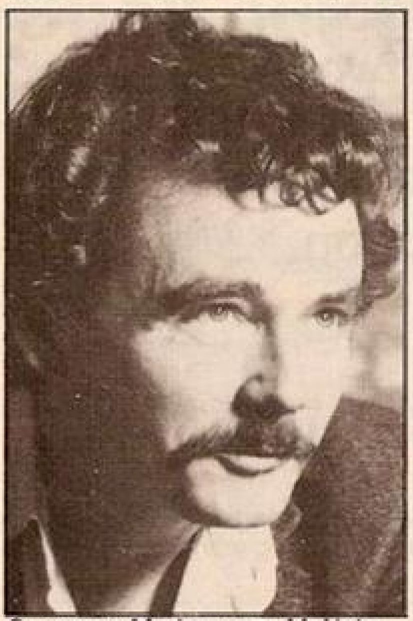
Display will be 40 columns with an 80-column option and there are outputs for TV and RGB monitor. If you lose your way in a program or just want to check what is happening you can call up a front panel display which gives details of the status of the program, on the right-hand side of the screen. Memotech designers Geoff Boyd and Robert Branton claim that the MTX-500 can produce 16 colours in high resolution — which is 256 × 192. Two joystick ports and a Centronics interface are built in and there is an RS-232 option. Three-channel sound is output through the TV — like the Vic-20 — rather than through an internal speaker.

The MTX-500 will be made in Witney, Oxfordshire by Memotech. For further details of the computer contact Memotech on 0993-2977.



Long distance information — try McNulty Spectrum Modems

SPECTRUM OWNERS will soon be able to enter the world of telecommunications — John McNulty has announced a Spectrum Modem for £50, and from July Micronet will be selling a Prestel adaptor for £90. The first 10,000 subscribers to Micronet can buy the adaptor now for the subsidised price of £50.



Spectrum Modem man McNulty.

With McNulty's Modem the Spectrum can be used to access world-wide databases, an electronic mail service, or simply to communicate with other Spectrums. The Modem, which can both answer and originate, is direct-connect and runs at 300 baud.

For £200 John McNulty is offering a Spectrum Starter Pack which includes a 48K Spectrum, the Modem and the RS-232 interface needed to connect the two. He describes it as providing people with the chance to learn about telecommunications at a fraction of the cost of a full, purpose-built terminal.

The Micronet package consists of all the necessary hardware and software to turn the Spectrum into a Prestel terminal — a direct-connect Modem, the interface circuitry and 8K of software in ROM — is housed in a box the same size as the Spectrum which fits underneath the machine.

It needs to be plugged in to a telephone socket and connected to the back of the Spectrum via a ribbon cable. On power-up, the software converts the Spectrum's display from 32 columns to 40-column Prestel format.

The system is menu-driven and includes some unusual facilities.

Volkswagen folk's micro

VOLKSWAGEN which invented the people's car is now producing micros for the people. VW subsidiary Triumph Adler is moving downmarket from business systems to produce a 64K £400 micro.

The PC comes complete with Centronics and RS-232 interfaces. There are TV and RGB monitor outputs, and games cartridges can be plugged in. The PC has a full-size, 79-key typewriter keyboard but although eight colours are available on screen the highest resolution possible is only 160 by 72.

Casio's latest piece of wallet-sized one-upmanship is the FX-802P pocket computer — which even has its own built-in printer. A QWERTY keyboard gives the option of single-key entry for Basic commands. The FX-802P can handle up to 10 separate programs with a total of 1,568 steps. A separate numeric keypad makes calculation easy. For a start you could work out that at £99.95, the FX-802P works out cheaper than buying one of the old pocket computers plus a printer.



From laser zaps to dead frogs Microl peps up your programs

IF YOU ARE TIRED of writing slow, boring Basic games and too lazy to get to grips with Z-80 machine code Microl have an idea to help you cheat.

An innocently-titled cassette called Game Effects contains a whole range of sneaky machine-code routines which you can call into a Basic program to produce high-speed spaceships, explosions and sėven million sound effects. John Peel of Microl admits that six million of the sound effects are pretty well indistinguishable but, as he says, there is still plenty of scope for "police sirens, helicopters, laser zaps, dead frogs and that sort of thing." Special visual effects and screen mixes are also part of the pack.

How Good is your Spectrum

If you're interested in finding out what your Spectrum can really do then you must go beyond the limitations of BASIC. Now, mastering machine code can be a reality with CRYSTAL COMPUTING'S MACHINE CODE UTILITIES.

Zeus Z80 Assembler

If you own a 48K Spectrum and want to exploit the potential of your computer to the full then Zeus is the perfect companion. For the beginner, Zeus is the ideal introductory aid. There has never been an easier way to enter and modify your machine code programs.

- Over 65,000 multi-statement lines.
- Auto-line numbering.
- List, search through, re-number and delete any section of the text.
- Full screen editor - simply move the cursor up into the program listing for instant word-processor style alterations, plus clearscreen, clearline, insert, delete, rubout and user definable tab stops.
- User Manual - with detailed explanations of assembler terminology and of all 24 commands.

For the experienced user, Zeus is simply the fastest and most flexible Z80 programming system available today. The high speed two-pass assembler accepts all Z80 mnemonics and features:

- Tokenized text maintained separately from BASIC.
- The ultimate in error trapping with extensive report codes.
- Hex, decimal or character constants.
- Operators, expressions, directives and comments.
- Up to 14 character alphanumeric labels and symbols.
- 9 invaluable monitor support facilities, including memory modify and a hex/decimal converter.
- Optional parallel output to ZX printer.

The Zeus Z80 operating system - more than a piece of software - an investment available NOW from Crystal Computing.

Spectrum Monitor & Disassembler

A superb memory editor, monitor and disassembler to enable easy entry, inspection and analysis of your machine code routines. Fast debugging is aided by breakpoint, register display, block print and tabulate, block copy, verify, a unique jump relative calculator and a versatile find command which displays all occurences of a specified set of bytes. Plus insert message, substitute, output to ZX printer and more. Accepts input in decimal or hex and there's even a machine code system designed to provide all the facilities you'll ever need.

This utility has been designed as the perfect compliment to Zeus. Having both co-resident in memory turns your Spectrum into a truly comprehensive Z80 programming unit. Now you can explore the excellence of your computer and open up a whole new world of programming.

Each utility comes complete with user manual for just £8.95 each.

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YOUR COMPUTER TOP 20

Game	Company	Machine
Arcadia	Imagine	Spectrum
Arcadia	Imagine	Vic-20
Black Crystal	Carnell	ZX81
Bonzo	Audiogenic	Vic-20
Choplifter	Creative Software	Vic-20
Donkey King	Microdeal	Dragon
Dragon Trek	Sala-mander	Dragon
Flight Simulator	Psion	ZX81
Football Manager	Addictive Games	ZX81
Galaxians	Artic	Spectrum
Gridrunner	Llamasoft	Vic-20
Gulp 2	Campbell Systems	ZX81
Hobbit	Melbourne House	Spectrum
Miner 2049er	Big Five	Atari
Penetrator	Melbourne House	Spectrum
Planet Invasion	Microdeal	Dragon
Rocket Raid	Acornsoft	BBC
Space Pirates	Bug Byte	BBC
3D Tanx	D K Tonics	Spectrum
Zaxxon	Datasoft	Atari

Cut and thrust in the price war as Sinclair reveals £99 Spectrum

SINCLAIR'S PRICE CUTS have sparked another micro war. The £25 reduction which has taken the 16K Spectrum below the £100 barrier has put pressure on Oric, while bringing the 48K Spectrum down from £175 to £130 has provoked a quick reaction from Commodore.

Now the £140 recommended price of a Vic-20 will include a £100 package of extras. The £10 cut in the cost of ZX-81s and ZX Printers to £40 has made the bottom end of the market less attractive for new micro companies.

Ironically Oric is having difficulty producing 16K machines for the original £99 price and was considering raising the price to £125 before Sinclair dropped its prices.



ZX-81 now £39.95

Spectrum now £99.95 for 16K, £129.95 for 48K.

Sinclair spokesman Bill Nicholls denied that the £99 price tag on the Spectrum was forced on Sinclair by Oric's pricing strategy. He said "This will keep us well ahead. It is not in reaction to anybody."

Psion Scrabble beats writers with 11,000 word memory

PSION'S SCRABBLE program for the 48K Spectrum consistently beats the programmers who wrote it. At the highest level it typically scores around 300 points in a two-player game and takes an average of 90 seconds to respond.

Scrabble costs £26.95 and was written under license from Little Genius who produced the disc-based version for the Apple II computer.

Some very clever compression techniques have been used to give the program a vocabulary of 11,000 words.

This is not as large as the average human vocabulary but includes the sort of nifty little words like "gnu" and "ai" that Scrabble players will find particularly useful.

New recorder free with Vic

COMMODORE'S RESPONSE to recent price cuts is not to cut Vic-20 hardware prices to £99 — as rumoured earlier this month — but to introduce a new software deal and include the cost of the dedicated recorder in the overall price.

Commodore's trendy design team has come up with a replacement for the Datasette dedicated cassette unit which was the £45.95 hidden cost of buying a Vic.

Commodore describes the new C2N unit shown above as "sturdy and more visually appealing".

The software deal consists of five cassettes — four games and one introduction to Basic. For £139 you get software and equipment worth £250 at old Commodore prices.

Shell out less for a turtle with Zeaker's two-tone seeker



MICRO-TURTLE is a robot which you can plug into any home computer. The £80 Zeaker Micro-Turtle can be controlled by your micro through a ribbon cable. It has a built-in retractable pen so that it can draw shapes on a piece of paper under keyboard or program command.

It can also be programmed to roam around the floor — and when it collides with an obstacle it will sound one of two notes on a horn depending on which side it has touched. After the collision the Zeaker sets off in another direction.

Colne Robotics which makes the Zeaker also produces a kit version for only £60. The Micro-Turtle can be plugged straight into a BBC Micro or any computer with an eight-bit bi-directional port. A £15 interface allows it to be used with the ZX-81 or Spectrum. Colne Robotics is on 01-892 8197.

Juggling with figures is what Neil Hooper is more used to. But now his company Micromega is adding games titles to its list of tax avoidance and personal banking programs for the ZX-81 and Spectrum. That's why he is spinning Roulette, Monte Carlo, Gulpman, Brainstorm and Dominoes cassettes through the air. Soon Micromega will also launch a range of space trader games which incorporate the challenge of Adventure games and the specific skill tests of landing on hostile planets or beating off attacks by invaders. It is all a long way from Comp-U-Tax, the do-it-yourself tax calculation program which established Micromega in the Sinclair market. Except when they are in the park you can find Micromega's juggling gypsies on 01-223 7672.

Arcade aces turn to micros to produce Jet Pac and Pssst

TAKE BRITAIN'S most experienced arcade game design team, set them loose on the home computer games market and you might expect to see some very high quality software. The team in question have formed a new company, Ultimate Play the Game, which has just released its first two, Jet Pac and Pssst, for the Spectrum.

Tim Stamper, one of the four directors of the company, believes their experience in the highly competitive arcade business will give them an edge over other software houses.

They previously designed games — building the hardware as well as writing the programs — for one of the largest arcade game distributors distributors in the States.

Ultimate Play The Game aims to produce a new game every two weeks. As Tim Stamper explains: "We have a lot of concepts just waiting to be programmed."

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Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

CROYDON REVISITED

Number two tries harder and Croydon Computer Club — the second largest in London — certainly does. Simon Beesley found the club thriving since *Your Computer's* last visit — and he also found out about robot ping-pong players, chip famine and static electricty.

WHEN *Your Computer* visited Croydon Computer Club nearly two years ago it was described as definitely thriving. It is clear that the club has continued to expand. The second largest club in London, it now boasts 150 paid-up members with a further 50 or so associate members. In the spirit of the Association of London Computer Clubs, the club is almost evangelical in its fervour to spread the gospel of computing. It is well represented at computer fairs and shows, is involved in local computing projects, and has had a hand in starting up some of the new clubs in the South London area.

One of the penalties of size is that the first of the club's two regular monthly meetings is somewhat lacking in the intimate atmosphere found at smaller clubs and has more the air of the public lecture. The second meeting, however, is given over to special interest groups which pursue such activities as programming in 6502 and Z-80 assembler.



Budding starship commanders try out a new BBC game at Croydon Central Reference Library.

When *Your Computer* visited the club the chairman, Vernon Gifford, announced that he was making his basement available to the Hardware Group and invited members to enter the 1983 version of the Micro Mouse competition. Rather than build a robot mouse which can find its way about a maze, contestants this year will construct a robot ping-pong player.

Being a large club, Croydon can attract high-calibre speakers. George Mell, who designed the computer graphics for the film *Alien*, had given a talk at a recent meeting and at this meeting almost 100 people had turned up to hear Neil Cryer talk about the BBC computer and its applications.

As it turned out Neil Cryer was unable to appear and his place was filled by Bob Foster from the Richmond Computer Club. He gave an off-the-cuff talk which contained various tips and pointers. Starting with a demonstration of Prestel on the BBC he then illustrated the transfer of programs from tape to disc. Miscellaneous topics touched upon included nylon carpets: the static electricity they generate — he warned — could damage a computer.

To demonstrate the Prestel adaptor Bob Foster had stored a number of Micronet's pages on disc. He was lucky enough to have Acorn's second version of Basic on board and he explained how one of the new commands, Oscli, made it easy within a short program to load any page off disc.

Croydon's BBC owners have been less fortunate in getting hold of peripherals and the latest operating systems. In the discussion afterwards, members revealed that they were suffering from the Great Acorn Chip Famine. The disc controller chip is in very short supply and the disc interface cannot be had for love nor money.

Evenings such as this one, devoted to a particular machine, are just one part of the Croydon club's calendar. Future events include talks on word processors and choosing a micro, and a disc symposium. The club meets in the Central Reference Library, Katherine Street, Croydon on the first and fourth Tuesdays of each month. ■

Local society news

Stockton workshops

STOCKTON Amateur Computer Club meets every Monday at the YMCA in Stockton, Cleveland, from 7.00pm to 9.00pm. Meetings alternate between evenings devoted to programming and workshop and games evenings. Over 12 months the club has built up a membership of 60, and among them are owners of most makes of home computer. For details contact Peter Cheshire on 0642-784819.

Thriving in Iver

THE IVER Computer society powered up for the first time on May 12th and now meets bi-monthly on the second and fourth Thursdays in the Huntsmoor Room at Iver Village Hall. The club caters for every level of enthusiast, from those just about to start to those already bitten by the bug. Contact John Haigh on Iver 654431 for details.

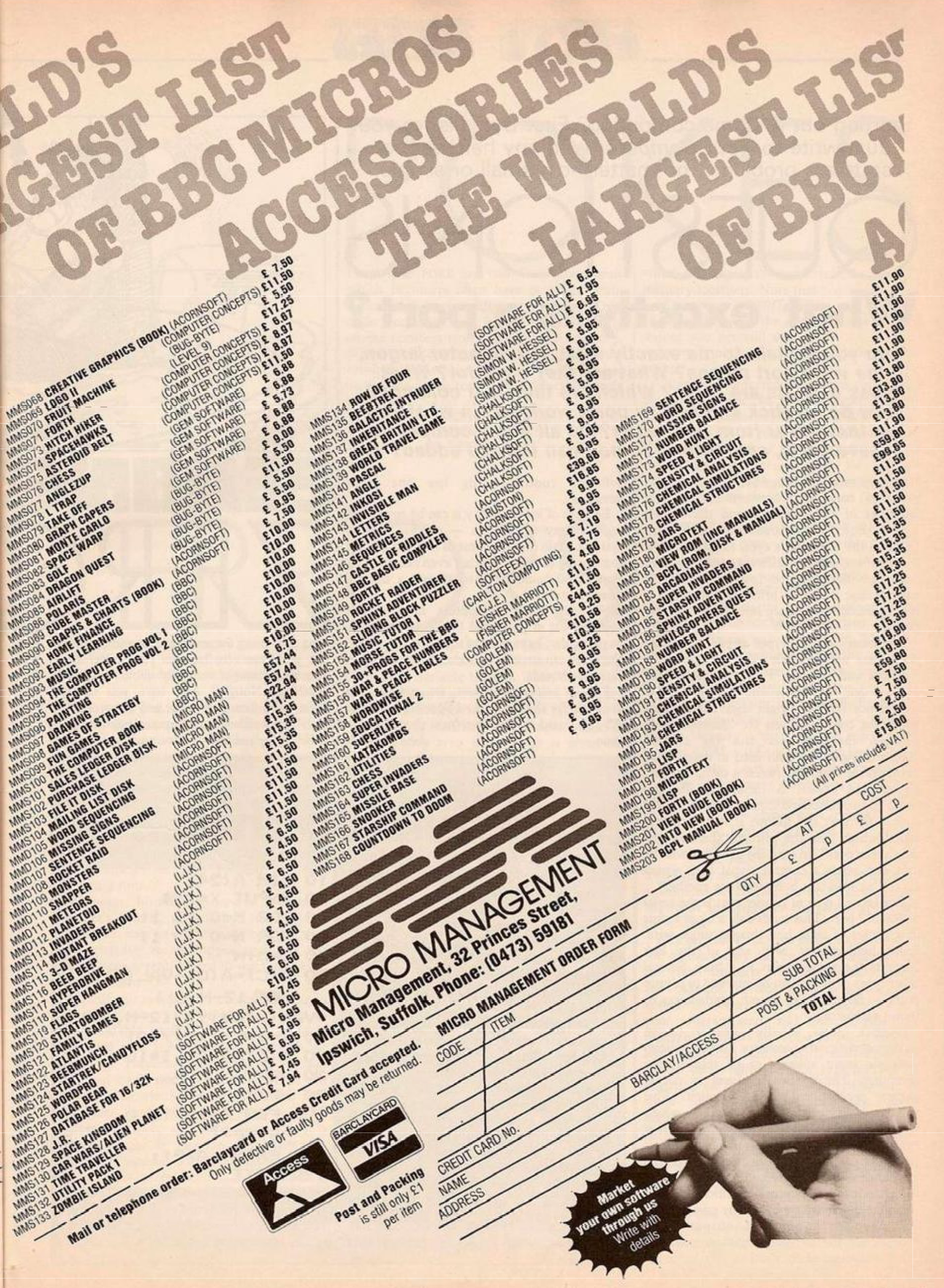
South Avon club formed

A MULTI-USER home computer club has been formed for the whole of the South Avon district. Regular meetings in Nailsea are planned as well as extra computer workshop meetings and a bi-monthly magazine. For more information contact the Secretary Valerie Boyde-Shaw on Nailsea 851337.

Micros of Penzance

FORSAKEN by Prestel and desperately short of dealers, is how the Penwith Area Computer Club describes the plight of the computer user in that part of Cornwall. The new club aims to promote computer literacy in the area and to stimulate the user of computers in local education. It meets every Friday in a room above the Penzance Micro Centre. Prospective members should phone Steven Zenith on Hayle 754845 or Paul Whitehead on Penzance 66336.


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QUESTIONS

What exactly is a port?

'Can you explain to me exactly what, in computer jargon, the word port means? What are they used for? What types of ports are there? Which are the most common? How do joystick and printer ports work and in what way do they differ from user ports? Do all home computers have ports, and, if they do not, can they be added?'

IN COMPUTER jargon the word "port" means a point of connection between the internal workings of the computer and the outside world. Equipment connected to a port becomes the computer's eyes, ears and hands.

There are several different types of port. Some are designed for specific peripherals such as disc drives or printers, others are of more general use and are referred to as "user ports".

The most common types of ports on home computers are the user port and ports for joysticks and printers. Printer ports usually come in one of two varieties. The parallel or Centronics type has eight data output lines and some control signals for "handshaking" between the computer and the printer. Handshaking is the term used to describe an exchange of signals between a computer and an external device. A handshake dialogue could go like this: the computer sends a byte of data to the port and follows it with a control signal which tells the printer "there is new data at the port". In turn the printer reads the data and sends a control signal back which says "I've read that byte, send me another".

The second type of printer port is the serial or RS-232 port. This sends data a bit at a time in a packet of eight bits along a single wire. Extra hardware at each end of the link converts the serial packet to a byte. Several other types of device can be attached to printer ports — for example, speech synthesisers or sound generators.

Joystick ports usually connect to an analogue-to-digital convertor which allows analogue input voltages to be read by the computer. The joystick produces an output voltage proportional to its position. This voltage is converted to a number which represents the joystick's position. Other devices producing output voltages such as electronic thermometers can also be connected instead of a joystick, giving the computer the ability to measure external conditions.

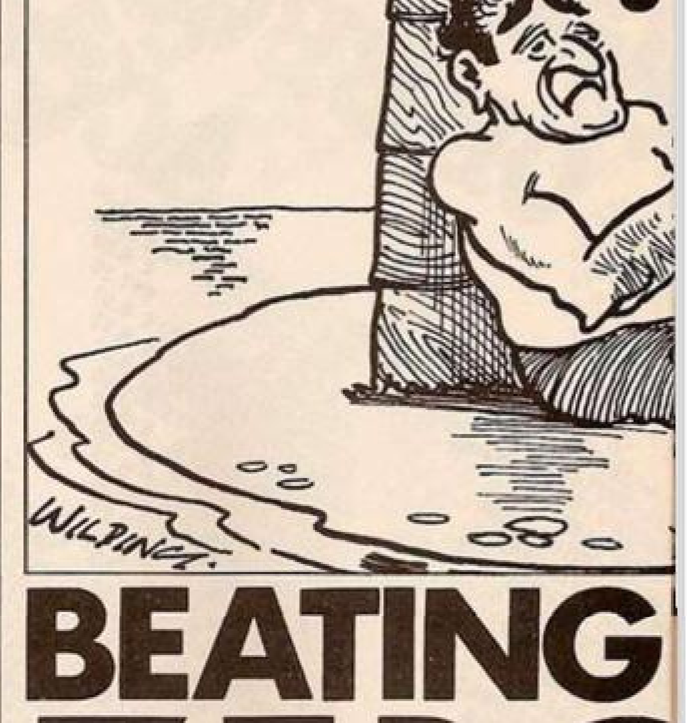
Unlike the joystick and printer ports, which are fixed as input and output ports respectively, the user port is bi-directional — it can be configured to Read or Write, under software control. This has one main advantage.

Because of its versatility it can be connected to a variety of devices — robots, heating systems, train sets are some of the possibilities that spring to mind. Sinclair even claimed that the ZX-80 could be used to run a nuclear power station!

Not all home computers have a full complement of ports and Sinclair computers, in particular, have none of the ports described. But they can usually be added by plugging in interface boards.

Parallel printer interfaces, for example, are available for the ZX-81 and Spectrum, and an RS-232 board for the Spectrum should arrive soon.

John Simpson



BEATING ZERO

ARE YOU going for zero bugs in your program? Do you have zero bugs in your code? Have you ever thought seriously about zero? Nil? Nothing? Nought? And have you thought about why these can cause and are problems? It is no wonder the computer has difficulty dividing by nought — have you ever tried it?

I could do that...

There is a popular word game which involves forming as many words as possible from the letters of a single six-letter word. Write a program to assist you in this task. It should accept a six-letter word as input and print out four letter word anagrams. Each anagram must contain at least one vowel and one consonant.

The winning program in April's multiplication problem came from K Reid, 126 Clayton Road, Chessington Road, Surrey. From a large number of entries this one managed to squeeze a solution into the fewest number of lines.

Please send your entries clearly marked "First Bytes Competition" to *Your Computer*. First Bytes competitions are judged two months after they are set, the closing date for entries is the last working day of the month in which the competition appears.

```
10 DIM A(24)
20 INPUT X$,Y$
30 FOR M=0 TO 11
35 FOR N=0 TO 11
40 C=M+N
50 A(C)=A(C)+VAL(MID$
   (X$,12-N,1))
*VAL(MID$(Y$,12-M,1))
60 I=INT(A(C)/10)
70 A(C)=A(C)-I*10
80 NEXT
90 NEXT
100 FOR P=23 TO 0
    STEP-1
110 PRINT A(P);
120 NEXT
```



POKES

PEEK AND POKE are two Basic commands which beginners often have problems with, although they are really very simple. They differ from most Basic in that they act directly on the numbers stored in computer memory. When you Peek into a memory location the result is the number stored there. The easiest way to see this is to run the following simple program:

```
10 FOR N=1 TO 255
20 PRINT PEEK(N);
30 NEXT N
```

which will display the numbers in the first 255 memory locations. Note that you must

```
PRINT PEEK
```

if you want to see the numbers, and that the values you get will depend on the way the memory is organised in the machine you are using.

Often the low memory locations contain the Basic interpreter, so you are looking at the numbers permanently fixed in ROM — Read Only Memory. If you have the memory map for your machine look for the memory location where program storage starts, for example 16514 on the ZX-81, and then change line 20 so that you start Peeking from that point. For example:

```
20 PRINT CHR$(PEEK(16513+N));
```

You should now see something more recognisable, as you are actually looking at your program. As you are now using

```
CHR$(PEEK)
```

you get the character representations of the numbers, but do not be too surprised if it does not look exactly as you wrote it. There are always hidden instructions in the program which are not displayed when you List it.

If you Poke a memory location you try to put the number you have specified into that byte. If you Poke into RAM — Random Access Memory — then you will succeed, but Poking ROM will have no effect; remember it is Read-Only. Look at your memory map for the start of the screen display, and try Poking the screen with different numbers.

```
10 S=(screen start address)
20 FOR N=1 TO 255
30 POKE S+N,N
40 NEXT N
```

You should now see a whole range of different alphanumeric characters, and perhaps also keywords and graphics characters, appear on the screen.

As Peek and Poke give direct access to all of the memory they can be very useful, as they can reach the parts other Basic cannot reach. For example, certain locations will contain system variables which tell the machine where your program starts and ends. If you Poke different numbers into these locations you can fool the system into thinking that things are not as they really are. For example Poking RAMtop on the ZX-81 allows you to reserve space for machine-code programs. Some dialects of Basic have Deek and Doke, which are just like Peek and Poke, except that they deal with two memory locations at a time, so they are useful when changing addresses — which take two bytes:

```
X=DEEK(1)
```

will tell you the 16-bit number in locations 1 and 2, which you must find otherwise with

```
X=PEEK(1)*256+PEEK(2)
```

Keith and Steven Brain

THE BUGS
ERRORS

One of the most natural errors to do with zero is the infamous "divide by" one. Not, you understand "divide by one", but "divide by zero".

This most commonly occurs in iterative loops where the program is performing some division operation on a variable that is being incremented or decremented each time round. The tragedy occurs when the unfortunate variable reaches zero. The program tends to fall over. Crash. The simplest solution to this is to introduce range checking on your variables. The loop itself should obviously do some of this for you, but adding in extra explicit checks for zero yourself can save debugging time.

Of course, historically, zero is a problem too. Let's face it, historically, zero did not even figure, and, no doubt partly because of its comparatively recent appearance on the number scene, zero is hard to teach and even harder to learn.

It is difficult to represent zero of anything in a realistic way, and this can lead to understandable confusion; a recent example discovered in a pre-release of an up-market educational program illustrates this. A child was given a selection of coloured objects and had to decide whether there were more reds than blues, more blues than reds, or equal numbers of both, and send them down a labelled chute. It was an extremely disconcerting moment for the child presented with a blank screen and asked to make a decision. Of course the correct decision — red equals blue — was not intuitively obvious. As a postscript to this it is interesting to note that this zero-zero possibility was taken out of the game before release.

A typical computing problem with zero is that most machines will automatically initialise a variable to zero. This, in itself, is not a problem; it is the programmers' lamentable forgetting facility that causes the problems. If a variable is used and a zero input would be correct, then even if no input is given the variable will contain zero — that is, a correct value.

Another problem, possibly the commonest of all is that computers count from zero — the bits in a byte are indexed from 0-7, the elements in an array are usually indexed from 0 up to the size of the array minus one, and strings are just inconsistent; sometimes they are indexed from 0 upwards, sometimes from 1.

Strings have their own special zero related problems: what is a nul string? What do the actual bytes representing that string actually contain? Nuls. It is obvious but what does it mean? And before the zero-slash combination arrived who could tell at a glance whether it was the letter O or the digit 0 being referred to? Try typing

```
LET A=O
```

— the letter not number — in Basic and see what happens. If you are lucky it may take your letter O, take it as a variable, initialise it to zero and make A equal to zero. If you are unlucky your program will fall over.

All in all, zero is quite a problem. However, it can become less of one if you are aware of it, and arm yourself against the dangers. It helps if you count from zero yourself, it helps if you initialsie your variables explicitly, it helps if you put in extra range-checking and value tests, but most of all, it helps if you think like your computer.

Piers Letcher

THE MEN WHO INVENTED ME WERE CLEVER ENOUGH TO MAKE ME THINK IN 'FORTH' (IT'S 10 TIMES FASTER AND 4 TIMES MORE COMPACT THAN 'BASIC').

YET THEY'RE DUMB ENOUGH TO SELL ME FOR £89.95!



Richard Altwasser and Steven Vickers are the men who invented the Jupiter Ace.

After years of designing micro-computers that use BASIC (both men played a major role in creating the ZX Spectrum), they abandoned it in favour of FORTH.

FORTH is just as easy to learn as BASIC. Yet it's a faster, more compact and more structured language that educationalists and professional programmers alike prefer.

So the Jupiter Ace is the only micro-computer you can buy that is designed around FORTH.

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The Jupiter Ace has a full-size keyboard, high resolution graphics, sound, floating point arithmetic, a fast, reliable cassette interface, 3K of RAM and a full 12 month warranty.

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The Jupiter Ace manual is a complete introduction to personal computing and a simple-to-follow course in FORTH, from first principles to confident programming.

Plug-on 16K and 48K memory expansions are also available, at very competitive prices. (There'll be a plug-on printer interface available soon, too.)

It'll take you no time at all to realise how clever Richard and Steven were to design the Jupiter Ace around FORTH. And even less time to realise what a silly price £89.95 is to charge for it.

Technical Information

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BBC SPEECH SYNTHESISER

Former newscaster Kenneth Kendall's voice has been captured on silicon for the £55 Speech Synthesiser, the new arrival in the BBC Micro's family of add-ons. John Dawson listens to the patter of its tiny beeps.

MY BBC MICRO now speaks BBC English — and it comes as no surprise to discover that its new urbane accent is modelled on ex-newscaster Kenneth Kendall's voice. The BBC Speech Synthesiser behind this development consists of two chips that plug on to the main printed-circuit board. In the future the ROM cartridge socket to the left of the keyboard will allow more predefined words to be added to the 165 words and word-parts held in the first onboard ROM. The Speech Synthesiser itself and the first ROM are available now and cost £55 which includes fitting. Acorn has coined a new piece of jargon — the chip containing the words and bits of words is called a PHROM, which stands for Phrase Read-Only Memory.

The Speech Synthesiser can be controlled from both Basic and assembly language. It is easy to use in Basic programs but things become increasingly complex as you move into assembly language and access the words in the PHROM, and even more difficult as you start to create your own words in RAM.

If you have a fast analogue-to-digital converter you can sample human speech as it occurs and then turn the varying electrical waves into digital numbers which can be stored on a gramophone record, a video cassette or in a computer. While this method gives the highest quality reproduction, the disadvantage is that colossal quantities of numbers are needed to store all the samples required to recreate the original sound.

Computer speech synthesis is largely concerned with the struggle to cut down the quantity of information — the digital numbers that you have to store to reproduce intelligible speech.

Human speech is a very complex affair. Several parts of your mouth and throat are involved in making the sounds that form each word. If you open your mouth and breath out you will hear a rushing sound without any recognisable characteristics. However, try closing your lips to form an "O" while keeping the cavity of your mouth open and then breathe out again. The quality of the sound changes and should now appear to be more "tuned".

The cavity in your mouth has reduced the amplitude of some frequencies more than others and has limited the range of the previous "white noise" sound. In the same way you can experiment by holding your throat gently while saying "No" and "Get". There is much more activity in your throat when you pronounce "Get", while "No" is produced mostly at the front of your mouth by your teeth and lips.

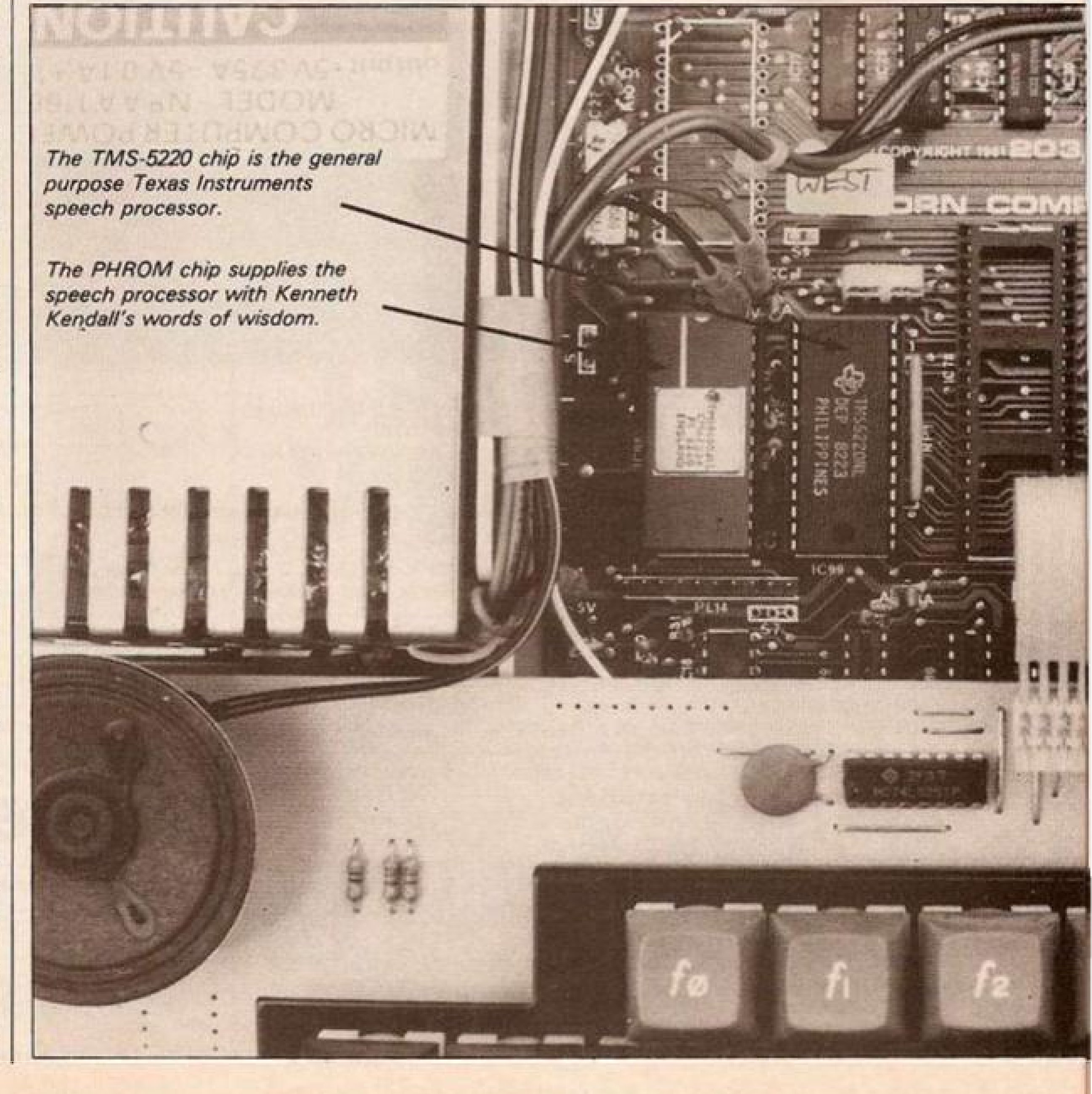
Speech can be recreated by recording someone speaking certain words, and then reducing the words to numbers. This method can achieve a high quality of reproduction but is limiting because one is confined to using the words originally stored in the system. Furthermore finding the word in an electronic dictionary in real time would soon become impossible using the speed and processing power of microcomputers. Proper names or new words would defeat the system completely.

The alternative is to break English speech down into its component parts and then reassemble them to make up words. The component parts are called phonemes and there are about 42 of these sounds in ordinary English. Other languages such as Japanese, Russian or Arabic have quite different sets of phonemes.

It is possible to break down ordinary text into significant groups of letters and then look up the corresponding phonemes for each group. These letter groupings are called "morphs" and Professor Allen of the Massachusetts Institute of Technology has identified 8,000 morphs that will describe at least 95 percent of the words in typical texts.

The Texas Instruments speech processor, TMS-5220, used in the BBC Speech Synthesiser is a general-purpose digital model of the human vocal tract. It can, therefore, be used either to pronounce complete, prerecorded words or to pronounce phonemes chosen by the computer's software to speak any word in the language.

The first PHROM supplied with the BBC Speech Synthesiser contains a number of complete words and some "word-parts" — not phonemes — that can be used to extend the range of the vocabulary. Another PHROM could be substituted for the first, or plugged into the cartridge ROM socket, containing the 42 phonemes in English. With the appropriate



The TMS-5220 chip is the general purpose Texas Instruments speech processor.

The PHROM chip supplies the speech processor with Kenneth Kendall's words of wisdom.



software the BBC computer would then have an unlimited vocabulary.

While you or I may find a Texas Speak and Spell machine bearable for 10 or 15 minutes at a time, an aircraft controller may be quickly fatigued by having to listen to compressed, distorted speech for the whole of an eight-hour shift. Clarity is not merely a cosmetic extra — it may be vital for the safety of an operation. The signal-to-noise ratio is important; it is tiring to have to drag the sense of what is being said to you from a lot of background noise. My BBC computer has a fair degree of buzz when it is "at rest" but I thought the Speech Synthesiser with the Acorn PHROM produced clear sound, particularly when a number of words were assembled into a sentence. The context in which the words were pronounced also made understanding easier.

For good reason Acorn insists that the job of fitting the Speech Synthesiser should be carried out by a dealer. The latest issue printed-circuit boards are correct but issues 1, 2 and 3 require some minor changes to a few address lines. Series 4 boards require no modification.

(continued on page 61)

Figure 1.

Word or word-part number	Word	Word or word-part number	Word
		209	Is
127	(0.125)	210	J,Jay
128	(0.25)	211	K
129	(Tone 1)	212	Key
130	(Tone 2)	213	L
131	-d	214	Large
132	-ed	215	Last
133	-ing	216	Line
134	-s	217	M
135	-teen	218	Many
136	-th	219	Minus
137	-ty	220	More
138	-z	221	Must
139	Zero	222	N
140	Hundred	223	Name
141	Thousand	224	Negative
142	One,won	225	New
143	Two,to,too	226	No,know
144	2- (twen-)	227	Not,knot
145	Three	228	Now
146	3- (thir-)	229	Number
147	Four,for,fore	230	O
148	4- (for-)	231	O'clock
149	Five	232	Of
150	5- (fif-)	233	Off
151	Six	234	Old
152	6- (six-)	235	On
153	Seven	236	Only
154	7- (Seven-)	237	Or
155	Eight,ate	238	P,pea
156	8- (eight-)	239	Parameter
157	Nine	240	Pence
158	9- (nin-)	241	Please
159	A	242	Plus
160	Acorn	243	Point
161	After	244	Positive
162	Again	245	Poun-
163	Amount	246	Press
164	An	247	Program
165	And	248	Q,queue
166	Another	249	R,are
167	Answer	250	Red
168	Any	251	Reset
169	Available	252	Return
170	B,bee,be	253	Run
171	Bad	254	Running
172	Between	255	S
173	Both	256	Same
174	Button	257	Score
175	C,see,sea	258	Second
176	Cassette	259	Small
177	Character	260	Start
178	Complete	261	Stop
179	Computer	262	Switch
180	Correct	263	T,tea,tee
181	D	264	Ten
182	Data	265	Thank
183	Date	266	That
184	Do	267	The
185	Dollar	268	Then
186	Don't	269	Third
187	Down	270	This
188	E	271	Time
189	Each	272	Try
190	Eleven	273	Twelve
191	Engaged	274	Type
192	Enter	275	U,you
193	Error	276	Uh
194	Escape	277	Up
195	F	278	V
196	Few	279	Very
197	File	280	W
198	First	281	Want
199	Found	282	Was
200	From	283	Were
201	G	284	What
202	Good	285	Which
203	H	286	X
204	Have	287	Y,why
205	I,eye	288	Year
206	Illegal	289	Yes
207	In-	290	Your
208	Input	291	Z

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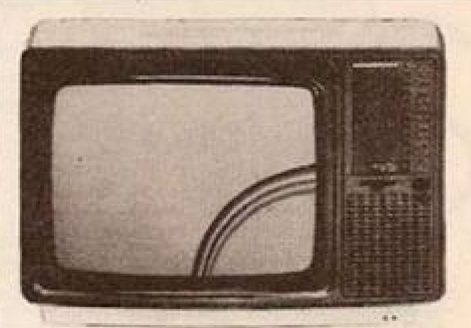
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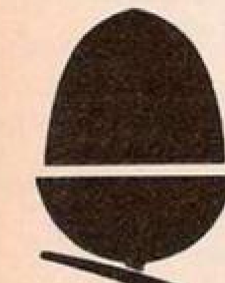
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(continued from page 59)

I confess that I would not have minded paying, at their risk, someone else to make the two or three circuit changes necessary because the printed-circuit board tracks that have to be altered are small and close together. Additionally, the instructions suggest that the Speech Synthesiser should be set up using a frequency meter to ensure that the pitch of the voice is correct.

Words are spoken by the Speech Synthesiser using a special form of the Sound command, and the ordinary uses of sound are not disturbed. The speech Sound command for the first PHROM takes the form:

SOUND -1, variable, 0,0

The -1 identifies the PHROM. Alternatives for the first number direct the speech generator to use a word from RAM instead of a PHROM, or choose a different PHROM. The second number — variable — selects the word to be spoken in one of three ways.

Either the word number in the PHROM is given, absolutely or as the result of evaluating an expression, or an ASCII character can be used to identify the word. The third method of identification uses the address of the word within the PHROM.

The last two zero parameters are necessary to maintain the syntax of the Sound command. There is no way of varying the volume of the Speech Synthesiser using software instructions.

The words in the PHROM supplied with the speech generator are set out in figure 1. Note that although there are a collection of complete words, there are also a set of word-parts such as:

-ing	-s
-d	-z
-th	in-

These can be added to other words in the collection to form new words like:

In- ten -d
Have -ing
Enter -ing
Enter -d

The instructions supplied with the two chips contain a great deal of useful information and two programs which demonstrate how the Speech Synthesiser can be operated from either Basic or assembly language.

At the most primitive level the notes suggest that you should type in

SOUND -1, word number, 0, 0

for almost every sound you wish to produce. This quickly showed me just how easy the chips were to control and it took less than five minutes to write the following program to speak a complete sentence:

```
10 REPEAT
20 FOR K = 1 TO 11
30 READ L
40 SOUND -1,L,0,0
50 NEXT K
60 RESTORE
70 UNTIL FALSE
80 DATA 205,167,131,267,198,271,275,246,
   131,267,174
```

The data in line 80 are the word numbers that make up the sentence "I answered the first time you pressed the button". Hardly a contribution to a Hemingway manuscript, but nevertheless an amazing technical achievement.

Figure 2, taken from the user instructions, illustrates some of the additional words that can be made up using word-parts from the vocabulary. Words like "seethe" and "witches" are clever examples, and you will be able to experiment for hours to explore the range of the chips' capabilities.

Figure 2. Some compound words made using word and word-parts.

Eye	I
Eyes	I -z
Feud	Few -d
Files	File -Z
Filed	File -d
For,fore	Four (4)
Fuse	Few -z
Goods	Good -z
Having	Have -ing
Inbetween	In- between
Incomplete	In -complete
Incorrect	In- correct
Indeed	In- d -d
Inner	In- uh
Intend	In- ten -d ·
Jay	J
Jays	J -z
Keys	Key -z
Knew	new
Lasted	Last -d
Lasting	Last -ing
Lined	Line -d
Minuses	Minus -z
Moor	More
Moors	More -z
Names	Name -z
Naming	Name -ing
News	New -z
Nose	No -z
Numbered	Number -d
Numbers	Number -z
Once	One -s
Pea	P
Peas	P -z
Pleases	Please -z

You can input a series of numbers into an array and then play the array through the Speech Synthesiser, automatically calculating the number of words to be pronounced. At a more serious level you may succeed in chopping off the front sections of words to create new word-parts. This can be done by sending a reset code to the Speech Synthesiser which halts the speech output in mid stammer, so to speak, and then continues with the next word in the queue.

In this way it should be possible to obtain the "w" sound at the beginning of "were", adding "-uh" and "-d" to obtain the conditional word "would". Approximately 20 words can be held in the queue, and after processing the instruction, the computer will go about its business while it simultaneously speaks the stored sentence.

Spoken words are an output device just like a visual display unit. Speech is a way of communicating information from the machine and in some circumstances it will be more useful, or safer, to attract a person's attention using speech than by flashing a message on to a VDU.

The main difference between the two is that a VDU displays a good deal of information simultaneously while a speech generator presents information serially — that is, one word after another. It can be difficult to grasp the content of a letter if it is read to you over the telephone because you cannot see the whole of a page at one time. Tables of figures may make a pattern from which you can gain important information; presented serially, you would struggle to create a picture in your mind. These problems affect everyone who is blind or seriously visually handicapped.

Normal vision is severely limited in a photographic darkroom and here, and in other similar environments, communication by speech can be a valuable, time-saving aid. Ear, nose and throat surgeons, working through microscopes in the tiny spaces of a patient's middle ear might usefully obtain information from a speech generator as might a pathologist counting cells of a particular type in a blood film. Electronic engineers who have rushed headlong into digital voltmeters might well appreciate the new freedom of looking at the piece of equipment under test or the service manual while voltages are spoken to them by a voltmeter.

CONCLUSIONS

- The limited vocabulary of the BBC Speech Synthesiser is due to the present phrase read-only memory or PHROM. Up to 16 PHROMS can be identified by the speech command — Sound -X,word,0,0 — and, in theory, those chips can generate speech in any accent you choose, and with either a defined or an unlimited vocabulary.
- Kenneth Kendall's English accent is a great relief after all the American imports of the past. Not only is the sound more pleasant to listen to, I think it is also easier to understand.
- The first PHROM contains a useful set of words with some important omissions. Obvious words such as "left" and "right", "north", "south", "east" and "west" would all have been useful additions.
- I would have liked to have heard some conditionals in the set, perhaps "would" and "could", as well as words to do with human interactions such as "like" or "people". The subtlety of the sentences that you could have produced would have been increased greatly.
- That criticism is easy to make in retrospect — by and large the set of words and word-parts will be enormous fun for games players as well as offering substantial help to computer users who are visually handicapped.
- Chopping words in the PHROM to obtain new word-parts is unlikely to appeal to many people but I confidently foresee add-on PHROMS and "dictionary discs" being made available from several sources.
- The Speech Synthesiser fits neatly inside the BBC case and it is easy to add a socket to connect a large speaker to the internal amplifier. Overall, a versatile and successful addition to the range of Acorn BBC peripherals. ■

Take your seats for the software sensation of the century. Bask in the reflected glory as Peter Connor gives the latest programs the big screen treatment.

Company	Game	Memory	Joystick/ Keyboard	Price
Llamasoft	Grid-runner	U	J	£6.00
	Traxx	8/16K	J	£6.00
	Laser Zone	8/16K	J	£6.00
	Abductor	U	J	£6.00
Software City	Defender on Tri	8/16K	J	£9.95
	Extermin-ator	U	J	£6.99
	Vikman	U	J	£6.99
Rabbit	Night-crawler	U	J	£9.99
	Space Phreaks	U	J	£9.99
	Quackers	U	J	£9.99
	Skramble	U	J	£9.99
	Hopper	U	J	£9.99
Quicksilva	Trader	16K	K	£14.95
	Tornado	3K	J	£5.95
	Skyhawk	3/8K	J	£7.95
Sumlock	Jumpin' Jack	U	JK	£7.95
	Gridtrap	U	JK	£7.95
	Gunfight	U	JK	£6.95
	Destroyer	U	JK	£7.95
	Scorpion	U	JK	£7.95
Romik	Moons of Jupiter	3/8/ 16K	J	£9.99
	Power Blaster	U	JK	£9.99
Audiogenic	Kaktus	8/16K	JK	£7.95
(Creative Software)	Man-grove	U	JK	£7.95
	Choplifter	C	J	£24.95
	Apple Panic	C	J	£24.95
	Serpen-tine	C	J	£24.95
Anirog	Frogrun	U	JK	£6.00
	Cavern Fighter	U	J	£6.00
	Crawler	U	J	£6.00
Commo-dore	Scott Adams	C	K	£24.95
Pase	Worm	U	K	£4.99

Company	Address
Audiogenic	PO BOX 88, Reading, Berkshire.
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Quicksilva	Palmerston Park House, 14 Palmerston Road, Southampton SO1 1LL.
Anirog	26 Balcombe Gardens, Horley, Surrey.
Rabbit Software	380 Station Road, Harrow, Middlesex, HA1 2DE.
Llamasoft	49 Mount Pleasant, Tadley, Basingstoke, Hampshire.
Sumlock	Royal London House, 198 Deansgate, Manchester M3 3NE.
Software City	3 Eden Walk Precinct, Kingston on Thames, Surrey.
Commodore	818 Leigh Road, Trading Estate, Slough, Berkshire.
Pase	213/215 Market Street, Hyde, Cheshire SK14 1HF.

ALMOST TWO years after its birth the Commodore Vic-20 has come of age as a games machine. The more imaginative new games reviewed here show that the Vic need not blush in the company of other, comparably-priced machines, thanks not so much to weary old arcade classics, but rather to novelties which boldly go where no game has gone before, seeking out new life-forms for jaded players.

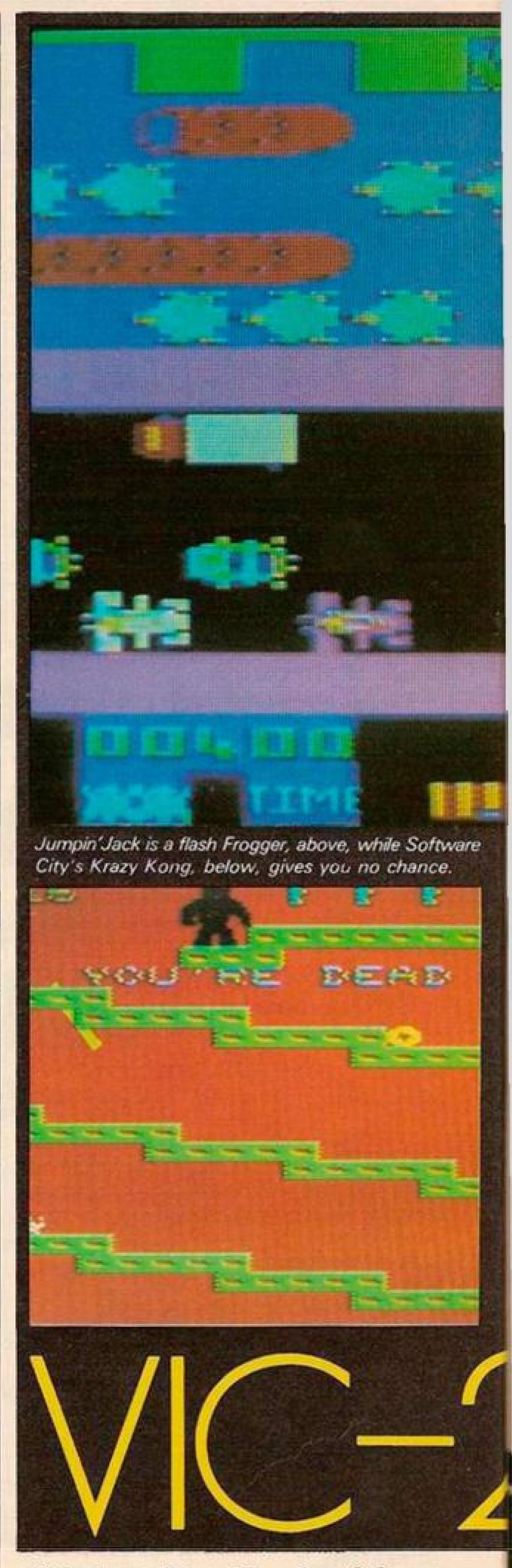
The blasé gamester's interest could be re-kindled by a range of musical introductions. Radio 3 listeners might appreciate Kaktus from Audiogenic, which opens with a few bars of Mussorgsky's *Pictures at an exhibition.* Less highbrow music-lovers might prefer Quackers from Rabbit Software, which repeats, *ad nauseam,* a fairground carousel tune. Those with a penchant for the exotic could do worse than try Creative Software's Serpentine which begins with a sleazy belly dancing tune full of Eastern promise — though it delivers snakes rather than cabaret. For the more avant-garde Vic owner, Pase has produced Worm whose opening sounds are challengingly tuneless.

But the game's the thing, and Gridrunner from Llamasoft is one of the most impressive. This exceptionally fast-mover cleverly develops an essentially simple idea. The screen is filled by a grid of red lines, on the bottom seven of which your ship, the Gridrunner, can move freely. Your opponents are the Droids who swarm down with alarming speed. Additional hazards are the X/Y Zappers which run along the boundaries of the grid emitting plasma pulses and plasma beams; where these meet a Pod is formed. This has to be hit repeatedly to be destroyed. When you have destroyed all the Droids in one wave you see the comforting message, "Grid Zapped". You cannot relax, though, since there are another 19 waves after that. Gridrunner is fast, noisy and compulsive.

Llamasoft has produced several other games which make the most of the Vic's graphics. Traxx is also a grid game, but here the sectors are quite large. The object of the game is to capture these squares while avoiding bugs that flutter about. Traxx is less frenetic than Gridrunner, but has its own attraction. It requires a delicate touch with the joystick to steer your way around the grid.

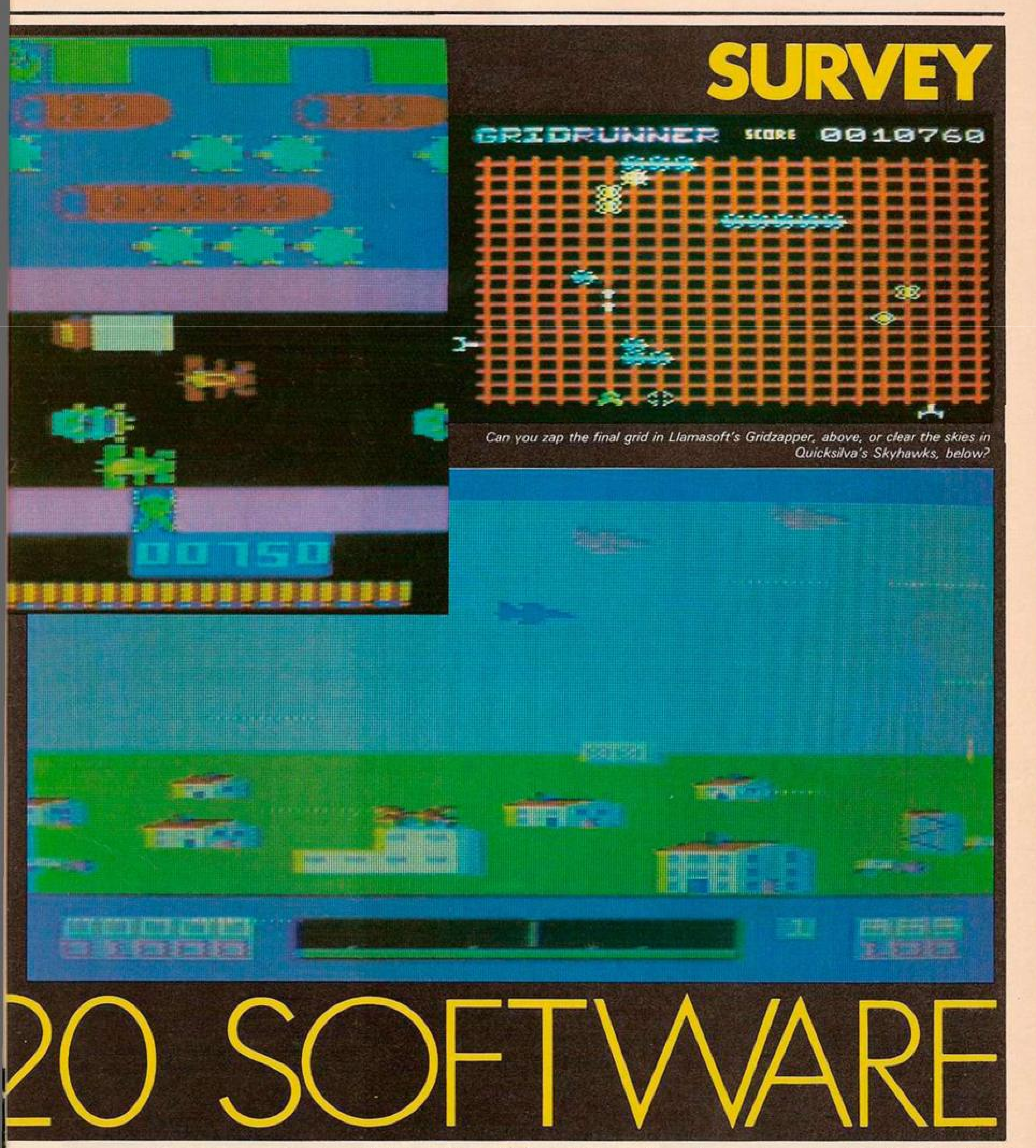
Laser Zone is another intriguing idea from the same company. Here you have two ships, one moving along the horizontal axis and the other along the vertical. The object is to vaporise the nasties, best done by co-ordinating the ships and mastering the art of diagonal firing.

Llamasoft's Abductor is an amusing variant on Galaxians. The aliens zoom down as usual, but, and here is the twist, kidnap your humanoids. There's no ransom though; you just have to destroy them before they reach the top of the screen, in which case you get your humanoid back. If you do not destroy them your humanoid becomes a grimy yellow shell which drops on you with unpleasant consequences.



Jumpin' Jack is a flash Frogger, above, while Software City's Krazy Kong, below, gives you no chance.

Defender on Tri — 3K — from Software City, is a novel game in which you pilot a spaceship through a maze to save a captured scientist. To avoid being smashed to smithereens on the walls you must use your shields which are heavy on fuel. You must therefore be skilful enough to pilot the ship without using the shields too much and quick enough to race around gobbling fuel dumps. Having picked up the scientist you exit to the



Can you zap the final grid in Llamasoft's Gridzapper, above, or clear the skies in Quicksilva's Skyhawks, below?

next page where yet stronger obstacles are encountered. Who can resist seeing if the aliens are meaner on the other side?

Software City also produces a very good version of Centipede, called Exterminator. According to the blurb, the principle of the game is to "Shoot everything that moves and everything that does not", which seems pretty clear. It is a very fast game with shuddering mushrooms and a 200-point snail whose pace is untypically quick for a mindless mollusc.

Vikman, SC's version of Pac-Man, is not the equal of the other two games. Its graphics are rather dull and the game rather slow.

Of the many good versions of Centipede for the Vic the best, by a segment, is Nightcrawler from Rabbit Software. It is exceptionally fast and furious with a plethora of multicoloured creepy-crawlies coming at you both horizontally and vertically. It is one of those games that automatically force the defeated player to cry desperately "I'm sorry, but I've got to have another go".

Not many of Rabbit's other games are up to this standard. Probably best of the rest is Speace Phreaks, a version of Galaxians in which you colonise a new planet and destroy the eponymous aliens. The one drawback of this fast-firing game is the background — the

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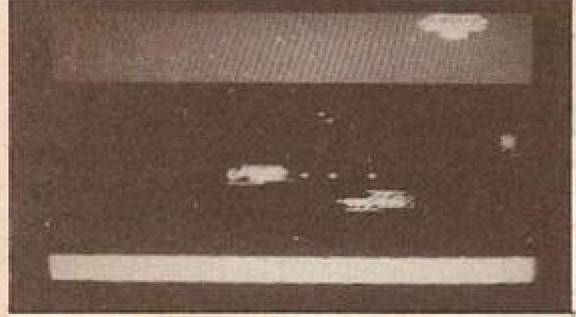
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twinkling little stars make it hard to see the alien missiles.

At first sight Quakers also from Rabbit, seems to be an original. A fairground shooting-gallery is colourfully represented, and carousel music conjures up the atmosphere of candy-floss, toffee-apples and muddy shoes. But it does not take long to see through all this; what we have here is a variation on Galaxians with the aliens — in this case, ducks — going quickly across, rather than down the screen. Nonetheless, it is a nice try at something different.

Rabbit's Skramble raises the question of which arcade games transfer well to the Vic. Rabbit's version is as good as anyone else's; which is to say that it is rather fuzzy and unexciting. The sound and speed of the Vic do not seem to be quite up to this kind of game. An intriguing aspect of Rabbit's Skramble, though, is the cutely-named Wiggy Tunnel, a cavern where you are attacked by what looks like extra-terrestrial tumbleweed. It is deadly, all the same.

Hopper is Rabbit's version of Frogger, the game where the frog has to cross road and river avoiding lorries and jumping on logs. This one has good graphics and compares favourably with its arcade relations.

Audiogenic is now distributing three games by the American company Creative Software. These are all cartridges which means they all contain their own extra memory and load very quickly. It also means they cost around £24 each, but some may well consider the extra price worth paying as all three have excellent



Creative Software's Choplifter.

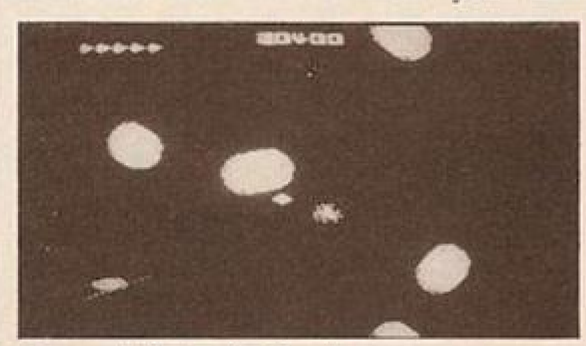
colour graphics and sound. In Serpentine you have to pilot a snake round a maze laying eggs to survive. You also have to avoid other snakes, which like to eat you.

Choplifter is, apparently, a best-selling game in the U.S.A. Here you have to pilot your whirly bird into enemy terrain and rescue hostages. Tanks fire at you, aircraft bomb you and there is a curious flying tin-opener which chops you into little pieces — at which point there is a disgusting splattering noise like the Spam going all over the kitchen. Apple Panic is the weakest of the three Creative games. This is what we British might call Monsters, where you go up and down ladders digging holes for the monster to fall through. I had always thought these were a rogue species of tomato, but apparently not. The instructions have an authentically American flavour: "Once an apple has gotten stuck in the hole, you have to mash it in . . . by beating it over the head". Violence, it seems, is as American as Apple Panic.

Audiogenic has itself also produced Mangrove, an original new game. The object is to defend your cells and allow them to grow. You are under constant attack from microbes and protection is afforded by moving your cells in the optimum manner. You also have three smart pills which, like Domestos, kill all known germs. This is an ingenious game with good graphics, which takes us to the very edge of the struggle for existence. Rubber gloves are not necessary.

Kaktus, also from Audiogenic, is a witty development of the Invaders/Galaxians theme. Here you are a gopher defending a large cactus from attack by hornets and wasps. There is also an unusually aggressive mole which gets you underground. Both these Audiogenic games are welcome because of their originality and quality.

Sumlock's Gridtrap is another interesting newcomer. You have to move your man



Moons of Jupiter by Romik.

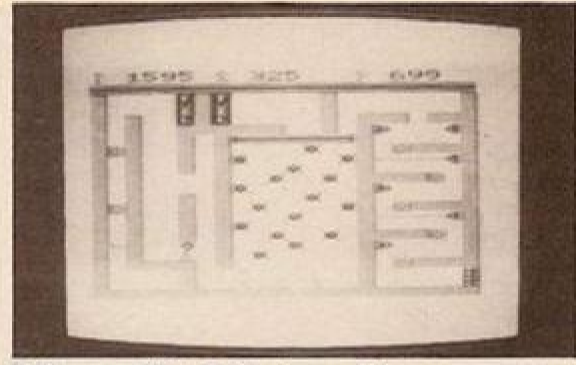
around a grid of traps defusing bombs within 60 seconds. Hazards are land mines and a roving boot which attempts to stomp you. As you cross the board the traps cave in behind you. Here you must use the Scroll keys to close up the ranks and enable you to move on.

Sumlock's version of Centipede is called Scorpion; instead of replicating mushrooms the screen is filled with cacti. A nice try at doing something new to a standard game, but it does not really make any difference. However, Scorpion is as good as most other Centipede games for Vic. Destroyer, also from Sumlock, features a ship depthcharging submarines and firing at bombers. Unfortunately, the sub's weapons are more like tadpoles than torpedoes and the game is rather slow and dull.

Like Destroyer, Sumlock's Gunfight is an intriguing idea which does not quite live up to expectations. Two mean old hombres blast away at each other in a rocky, cactus-studded desert. The graphics in this two-player game are rather dull, though, and it does not grip the player. Jumpin' Jack Sumlock's version of Frogger, is much better. The graphics are good, and the game is the equal of other similar ones for the Vic. There is a rather tedious tune, but you can always turn the sound down.

From Quicksilva comes The Trader Trilogy — 16K — which is an entertaining blend of adventure and game. You travel through the Meridien System bargaining with its various life-forms. Prepare to be humiliated by the Psions who "thrive on mental activity" and will ask you to do hard sums very quickly. Beware of the Deltans who would mug their grannies for a grain of that far-out inter-galactic drug Boosterspice. As well as the adventure side of Trader, there are various tasks to be performed such as piloting your ship into dock or finding your way round a Pac-Man style maze.

Quicksilva also produces, for the unexpanded



Software City's Defender on Tri.

Vic, Tornado and Skyhawk. Both are variants of Scramble, the former having the usual rugged terrain and the latter a deceptively peaceful-looking village.

The graphics are good, but sound is fairly limited. Of the two, Skyhawk is perhaps the more interesting as it involves landing to refuel, a trick which is rather difficult to master.

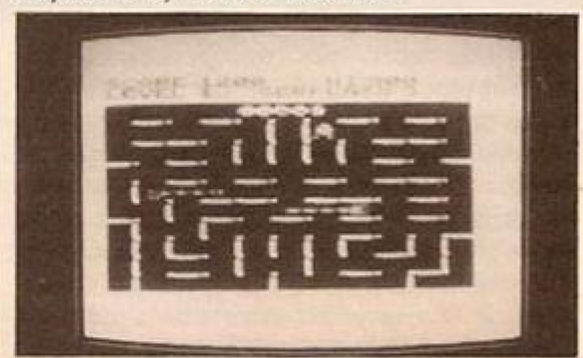
Romik's Moons of Jupiter is one of the few versions of Asteroids I have seen for the Vic. Graphics and sound are both good, and if you like Asteroids you will not be disappointed with it. Power Blaster, also from Romik, claims to be Venusians against Martians, but to me it looked more like a variation on Pac-Man. Your ship is in a maze and you have to blast the dots in front of you before you can move.

Anirog's version of Frogger is Frogman and again, it is pretty good, with graphics and sound up to the standard of any other version. Cavern Fighter is their Scramble-type game and in contrast of Frogrun is rather dull. It is slow and the graphics are crude; the so-called Fireballs are really purple jellyfish. Crawler is much better. This is Anirog's Centipede game and like all the others, is very fast and exciting with lively graphics.

There are not too many adventure games around for the Vic, but Commodore itself has produced a series of cartridges called the Scott Adams Adventure series. I confess that I do not see the attraction of adventure games in general, but I do not think I am being harsh when I say that the Scott Adams series is tedious. The commands and vocabulary are as limited as the original ideas. When you are stuck in the quicksand you just say swim and you are suddenly at the shore of a lake.

Most software houses have produced at least one game which deserves to be seen. The most impressive games for the Vic are the ones with the most original ideas Gridrunner, Mangrove, Gridtrap; such games show that not only does the Vic deserve to be considered as a games machine, but that home computer software does not necessarily have to imitate slavishly the fashion of the arcade. ■

Serpentine by Creative Software.



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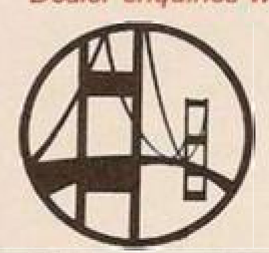
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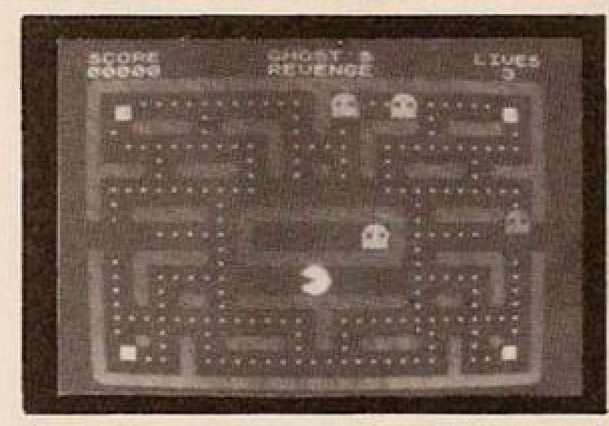
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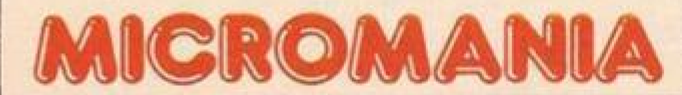
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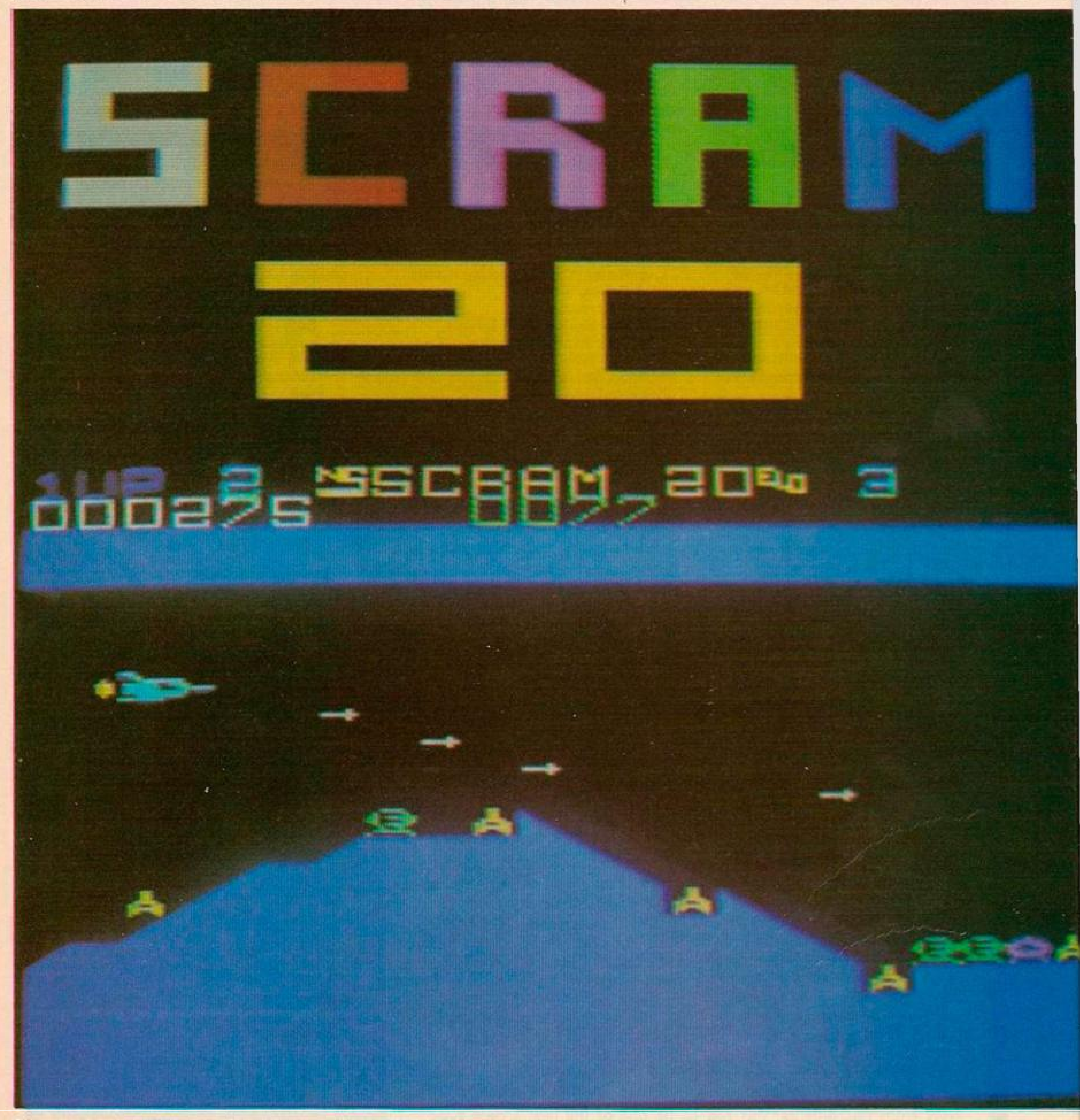
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CORRIDORS

SCRAM-20 ALLOWS you to use a joystick or keys and opt for one or two-player games. You can fire four bullets or two bombs at a time. The game was written without an assembler. I used a modified version of listing 2, the Basic loader, but I would now strongly advise anybody who wishes to write machine-code programs to purchase an assembler of some sort — it makes life a great deal easier.

Even though Scram-20 runs on an unexpanded Vic-20 you will need a Vic with a monitor or a 3K expansion fitted to load it. If you have a Vic with greater expansion, then use these Pokes to reconfigure it to 3K for entering the program. Type, in direct mode:

POKE 641,0: POKE 642,4: POKE 643,0: POKE 644,30: POKE 648,30: SYS 64824.

To make your Vic think it is unexpanded for the purpose of running Scram-20:

POKE 641,0: POKE 642,16: POKE 643,0: POKE 644,30: POKE 648,30: SYS 64824.

The reason you need an expanded Vic to enter Scram-20 is that the object code occupies nearly all available memory in the unexpanded Vic. However if you have an unexpanded Vic with a machine-code monitor, you should be able to enter the code.

The game itself loads in two parts; first comes listing 1 and then the object code. Listing 1 prints Scram-20 in big letters, sets up the zero page for use, disables the stop key

VIC-20

OF FIRE

Your mission is to destroy the enemy base. Your high-speed ship has 100 units of fuel which can only be replenished by hitting fuel dumps — each worth 25 units and a bonus 10 points. Beware of deadly anti-intruder missiles worth 50 or 150 points and the indestructible mines — Zoids and Superzoids. The purple Glamps are harmless but worth 95 points each, and keep an eye out for those UFOs. Remember — this machine-code game for the Vic-20 by Nalim Sharma is fast, very fast, and as you keep clearing the screens it keeps getting faster. So, take a deep breath, sit down in your armchair spaceship and set the controls for Scram-20.

and the restore key, and sets up the kernal for loading the object code file.

So the first thing to do is to key in listing 1, check it carefully and then save it. Now you must enter the object code. This will require a lot of time and patience, but it is worth it. It is best to enter it in stages, that is 500 numbers per day or however many you feel you can manage. It is for this reason that you should use a different cassette to the one on which listing 1 resides. Once you have finished entering all the code then you should record it following listing 1 — be sure to get the correct position after listing 1 by verifying it. All locations are in decimal: numbers are in hex.

If you have a machine-code monitor then you can happily enter the code. However, you must save from location 4100 to 7679 inclusive with an end-of-tape marker. Also the file must have no name. On the other hand if you do not have a machine-code monitor you must do the following: Fit a RAM expansion pack on to your Vic. If it is not a 3K, reconfigure it as I have shown. Key in listing 2. This is your Basic loader, and do not forget to save it.

Now you can run it and you will be confronted with a menu:

1. Enter Code
2. Check Code
3. Load Code
4. Save Code

On pressing 1 you must give the starting and finishing address — in decimal — of the locations you wish to enter into. Once finished, you will return to the menu. On pressing 2 you must also give the start and finishing addresses and this will allow you to view each location on a separate line. While checking, you may press P — this will pause indefinitely. To turn the pause off, press P again. Also you may edit locations by pressing E. Then you must: enter the location to be edited, press Return; enter the hex number and then press return. To escape the edit mode and return to the checking mode, enter the location as zero and the hex number as zero.

Pressing 3 will allow you to load a file into the memory, so you can then enter more of the code or whatever. Anyway, the starting address for the load should always be 4100. Once finished loading, you will return to the menu.

Pressing 4 will save from locations 4100 to 7679 with an end-of-tape marker and no name. Once completed you will return to the menu.

Speed controls

Once you have finished keying in everything, you can try loading Scram-20. I cannot emphasise enough that you should check any code you have just entered, otherwise you are bound to have trouble. So if it does not work, it is more than likely that the errors will be in the code, and you will just have to check through painstakingly.

Location 4280 controls the speed of Scram-20 and is the one you may wish to alter, 43 hex is about right. Any higher and the game will get slower whereas lowering it will make the game faster.

One last thing: how to make a copy of Scram-20 once you have it on a cassette. First, make sure the Vic is unexpanded, second type

LOAD"SCRAM 20"

and this will load the first part. Third type

SAVE"SCRAM 20"

to save the first part on another cassette. Type

NEW

put the original cassette into the unit and type

LOAD "",1,1

Put the new cassette in and type

SAVE"",1,2

You should now have a copy. Do not forget to press Return. The controls are as follows: in the keyboard version press D to go up, F for thrust, V to go down, colon for bombs, semicolon for lasers; in the joystick version push forward to go up, left for bombs, right for thrust, back for down.

There are five screens in Scram-20. In the first, which is blue, you must fly over a mountain range avoiding the rockets which will fire upwards in an attempt to destroy you. The Glamps hang glumly around the fuel dumps.

Screen two is green and closes in a little. The surfaces become a rocky terrain. You now face the UFOs which bounce up and down and generally get in your way. There are also fuel dumps and Glamps.

On the third screen — purple — the surface changes and you must now do battle with rockets, as in sheet 1, and Zoids which travel from right to left. Remember that Zoids are invulnerable except to rockets. Clumps of Glamps and fuel dumps still proliferate at this level.

Deadly Superzoids

The fourth screen is cyan, or greenish-blue and becomes very narrow and you must avoid the deadly Superzoids. These are identical to Zoids except that they travel twice as fast. At this level it is very easy to crash into the walls. Also present on the surface are fuel dumps, Glamps and harmless rockets.

Screen five is red and requires precision flying, bombing and shooting — no joke. You must fly through what will seem like an endless zig-zag. The fun part is that in doing this you must also do battle with rockets as in sheet one. Also there is the occasional fuel dump to bomb or strafe.

Now comes the central target of your mission — the Base. Once you have completed screen five, you will see the enemy base made up of green power cells. On bombing or shooting the base, you will witness a special effect. Once this is over, you will get 5,000 points and an extra life and you have to start again; the game just keeps on going. When you complete one sheet and so on to the next, the game speeds up and just keeps on becoming faster each time you complete a sheet.

By pressing the pound sign you may halt the game at any time. Fl will restart the game for you. The score on the top left is for player 1 and on the top right is the score for player 2. The fuel is shown — top centre — in green.

If you are unable to key in Scram-20 but would like a cassette of it, then send £3 — including postage and packing — to: Scram-20 Offer, 35 Kitchener Road, Walthamstow, London, E17 4LJ.

(continued on page 69)



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(continued from page 67)

```
2 REM FOR "@" READ INVERSE POUND SIGN
3 REM CTRL + KEY 3
4 PRINT"♥":POKE36879,8:PRINTCHR$(8)
5 PRINT" ■■  ■ ■■  ■ ■■ ▼ ■■  ■ ■■▼ ■"
6 PRINT" ■■ ■  ■■ ■  ■■ ■ ■ ■ ■■ ■ ■ ■ ■■ ▼ "
7 PRINT" ■■  ■ ■■ ■  ■■ ▼ ■■  ■ ■■ ■▼■ "
8 PRINT"  ■■ ■ ■■ ■  ■■ ■ ■ ■ ■■ ■ ■ ■ ■■ ■  ■ ■"
9 PRINT" ■■  ■ ■■  ■ ■■ ■ ■ ■ ■■ ■ ■ ■ ■■ ■  ■ ■"
10 PRINT"■■   ■   ■ ■   ■"
11 PRINT"      ■ ■ ■ ■   ■ ■"
12 PRINT"     ■   ■ ■ ■   ■ ■"
13 PRINT"     ■ ■   ■ ■   ■ ■"
14 PRINT"     ■   ■ ■   ■"
20 PRINT"■■     ■■COPYRIGHT 1983"
30 PRINT"■     ■ANALIN SHARMA■■"
31 DATA1,5,26,37,48,23,23,23,23,23,23,23,23,23,25,25,24,24,24,24,24,24,24,24,24
,32,25,25
32 DATA25,25,25,25,25,25,25,25,32,23,23,23,23,25,25,24,24,24,24,32,23,25,25,25,
23,25,25
33 DATA25,23,25,25,25,23,25,25,25,23,25,25,25,24,24,24,24,24,32,0,1,1
34 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0
35 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
36 DATA162,0,232,189,112,23,149,0,224,143,208,246
37 DATA169,194,141,20,3,169,3,141,30,145
40 DATA169,1,162,1,160,3,32,186,255,169,0,32,189,255,169,0,162,4,160,16,76,1,16
50 POKE4097,32:POKE4098,213:POKE4099,255
60 FORX=0TO180:READA:POKEX+6000,A:NEXT
70 SYS6144
```

Loader program.

```
5 REM FOR "@" READ INVERSE POUND SIGN
6 REM CTRL + KEY 3
9 POKE56,15:POKE52,15:POKE55,250:POKE51,250:CLR
10 PRINT"■■■   MACHINE CODE AID   "
20 PRINT"     ■■1■=ENTER CODE"
25 PRINT"■     ■■■2■=CHECK CODE "
27 PRINT"■     ■■■3■=LOAD CODE "
30 PRINT"■     ■■■4■=SAVE CODE "
40 GETA$:IFA$=""THEN40
43 V=VAL(A$)
47 IFV>2THEN50
48 INPUT"START,FINISH";UU,VV
50 IFV=3THENGOSUB 500:GOTO10
51 IFV=4THENGOSUB 600:GOTO10
52 FORX=UUTOVV
54 IFV=2THENDT=PEEK(X):D=DT:GOSUB110:PRINTX;H$:GOTO61
55 PRINTX;:INPUTH$
56 GOSUB320
57 POKEX,DT
61 FORDE=1TO50:NEXT
62 GETO$
63 IFO$="P"THENGOSUB450
64 IFO$="H"THENGOSUB460
65 IFO$="D"THENGOSUB470
66 IFO$="E"THENGOSUB480
70 NEXTX:GOTO10
110 REM*** DEC-HEX ***
122 DD=D:H$=""
125 IFD=0THENRETURN
127 IFD>65535ORD<0THENRETURN
130 FORI=3TO0STEP-1
140 Z=D/(16↑I)
150 IFZ<1THENH(I)=0:GOTO185
160 H(I)=INT(Z):D=D-(H(I)*(16↑I))
185 IFH(I)>9THEN195
190 H$=H$+CHR$(H(I)+48)
193 GOTO200
195 H$=H$+CHR$(H(I)+55)
200 NEXTI
220 FORDE=1TO50:NEXT:RETURN
320 REM*** HEX-DEC ***
322 DT=0
325 IFH$="Z"THENPRINT"■        ■DONE":RETURN
327 FORDE=1TO50:NEXT
330 HL=LEN(H$)
335 IFHL>4THEN322
340 FORI=HLTO1STEP-1
350 A=ASC(MID$(H$,I,1))
360 IFA>60THEN390
370 A=A-48
380 GOTO400
390 A=A-55
400 DT=DT+(A*(16↑(HL-I)))
410 NEXTI
430 RETURN
450 GETA$:IFA$<>"P"THEN450
451 RETURN
460 PRINT:INPUT"HEX ";H$:GOSUB320:PRINT"♥"TAB(11);DT
461 IFH$="0"THENRETURN
462 GOTO460
470 PRINT:INPUT"DEC ";DZ:D=DZ:GOSUB110:PRINT"♥"TAB(12);H$
471 IFDZ=0THENRETURN
472 GOTO470
480 PRINT"         ■EDIT":PRINT:INPUT"LOC ";LO
481 INPUT"HEX ";H$
482 GOSUB320
483 PRINT"■■"LO;" = ■"H$;"  = ■"DT
484 IFLO=0THENRETURN
485 POKELO,DT:GOTO480
500 POKE780,1:POKE781,1:POKE782,3
501 SYS65466:POKE780,0:SYS65469
502 PRINT:INPUT"■START";SR:POKE782,INT(SR/256)
503 POKE781,SR-(PEEK(782)*256)
504 POKE780,0:PRINT"        ■■■LOADING■":SYS65493:RETURN
600 POKE780,1:POKE781,1:POKE782,255:SYS65466
601 POKE780,0:SYS65469:POKE780,0:POKE781,255
602 POKE782,29:POKE0,4:POKE1,16
603 PRINT"        ■■■SAVING■":SYS65496:RETURN
```

Scram-20 main listing.

```
4100 A9 01 A2 01 A0 03 20 BA FF A9
4110 00 20 BD FF A9 00 A2 00 A0 00
4120 20 D5 FF EA EA EA EA A9 FF 8D
4130 05 90 A9 93 20 D2 FF A2 FF E8
4140 E0 03 F0 0F B5 0A D5 67 F0 F5
4150 D5 67 10 05 A2 00 20 7C 1B A2
4160 FF E8 E0 03 F0 0F B5 0A D5 6A
4170 F0 F5 D5 6A 10 05 A2 03 20 7C
4180 1B A2 00 BD D0 1D 9D 06 1E A9
4190 07 9D 06 96 E8 E0 0A D0 F0 A2
4200 04 BD D9 1D 9D CE 1E A9 03 9D
4210 CE 96 CA E0 00 D0 F0 A0 00 A9
4220 F0 35 0A 4A 4A 4A 4A 99 FA 1E
4230 A9 0F 35 0A 99 FB 1E A9 01 99
4240 FA 96 C8 99 FA 96 C8 E8 E0 07
4250 D0 DF A2 FF E8 A9 00 95 67 E0
4260 05 D0 F7 A9 03 85 65 85 66 A9
4270 01 85 4B 85 4C 85 4D 85 4E A9
4280 43 85 4F 85 50 A2 00 BD F4 1D
4290 9D 68 1F A9 01 9D 68 97 E8 E0
4300 05 D0 F0 A2 FF 20 89 1B A9 20
4310 9D 68 1F E8 E0 05 D0 F6 A2 FF
4320 20 89 1B A5 C5 C9 40 F0 D4 C9
4330 27 F0 07 C9 2F F0 06 4C BD 10
4340 A9 01 4C FB 10 A9 02 85 63 A9
4350 55 85 64 20 B5 1B 20 99 1B 85
4360 73 85 70 A9 01 85 00 A9 FF 85
4370 4A A9 01 85 6F 20 A6 1B A2 74
4380 95 00 E8 E0 84 D0 F9 A9 DC 85
4390 71 A9 1E 85 72 A9 0F 8D 0E 90
4400 A5 65 8D 04 1E A5 66 8D 11 1E
4410 A9 03 8D 04 96 8D 11 96 85 51
4420 A5 64 29 03 85 8D A0 01 C4 63
4430 F0 1D A6 8D A9 00 D5 64 D0 26
4440 A5 64 49 FF 85 64 29 03 85 8D
4450 A6 8D A9 00 D5 64 D0 14 4C 29
4460 10 A9 55 85 64 A9 01 85 8D A9
4470 00 C5 65 D0 03 4C 29 10 A2 00
4480 BD DE 1D 9D CF 1E A9 05 9D CF
4490 96 E0 03 F0 04 E8 4C 80 11 A2
4500 00 BD E2 1D 9D F9 1E A9 05 9D
4510 F9 96 E0 06 F0 04 E8 4C 95 11
4520 E8 A5 8D 9D F9 1E A9 01 9D F9
4530 96 A9 00 85 52 A2 05 20 89 1B
4540 E6 52 A5 52 8D 0C 90 C9 0A D0
4550 F0 20 B5 1B 20 B2 1A A2 00 A9
4560 19 9D E4 1F A9 07 9D E4 97 E0
4570 15 F0 04 E8 4C CF 11 A5 70 C9
4580 00 D0 09 A5 6F C9 00 D0 03 4C
4590 C9 18 A4 73 A9 20 91 71 C8 91
4600 71 C8 91 71 A0 00 A5 75 C9 00
4610 F0 04 A9 20 91 74 A5 77 C9 00
4620 F0 04 A9 20 91 76 20 C5 1B A2
4630 FF E0 0B F0 21 E8 B5 55 85 84
4640 E8 B5 55 C9 00 D0 04 E8 4C 17
4650 12 85 85 E8 B4 55 C0 FF D0 01
4660 C8 A9 20 91 84 4C 17 12 A0 00
4670 A5 8D AA C9 01 F0 02 A0 13 A5
4680 8D 99 00 1E A9 20 99 01 1E A9
4690 25 99 02 1E 38 A9 07 F5 4A 99
4700 00 96 99 01 96 99 02 96 20 68
4710 1D A5 C5 C9 40 D0 03 4C 1F 13
4720 C9 06 D0 03 20 F8 1A EA EA EA
4730 EA C9 16 D0 2D A2 01 B5 78 C9
4740 00 F0 0A E0 0A F0 17 E8 E8 E8
4750 4C 81 12 CA A5 71 95 78 E8 A5
4760 72 95 78 E8 A4 73 C8 C8 94 78
4770 A9 01 C5 6E D0 01 60 4C 82 13
4780 C9 2D D0 2E A2 01 B5 74 C9 00
4790 F0 09 E0 03 F0 E6 E8 E8 4C B2
4800 12 CA A5 71 18 E6 73 65 73 95
4810 74 C6 73 A5 72 69 00 E8 95 74
4820 A9 01 C5 6E D0 01 60 4C 82 13
4830 C9 12 D0 1C A5 72 C9 1E D0 06
4840 A5 71 C9 2C F0 0D 38 A5 71 E9
4850 16 85 71 A5 72 E9 00 85 72 4C
4860 82 13 C9 1B D0 0E 18 A5 71 69
4870 16 85 71 A5 72 69 00 85 72 EA
4880 C9 2A D0 08 A9 0F C5 73 F0 02
4890 E6 73 4C 82 13 A9 01 85 6E A9
4900 00 8D 13 91 A9 7F 8D 22 91 AD
4910 11 91 85 8E AD 20 91 85 8F A5
4920 8E 29 20 C9 00 D0 03 20 7F 12
4930 A5 8E 29 10 C9 00 D0 03 20 B0
4940 12 A9 00 85 6E A5 8E 29 04 C9
4950 00 D0 03 4C E2 12 A5 8E 29 08
4960 C9 00 D0 03 4C EB 12 A5 8F 29
4970 80 C9 00 D0 03 4C 14 13 A5 8E
4980 29 30 C9 30 D0 08 A4 73 C8 00
4990 F0 02 C6 73 A4 73 C8 B1 71 C9
5000 20 F0 03 4C C9 18 C8 B1 71 C9
5010 20 F0 03 4C C9 18 20 B2 1A A9
5020 08 20 54 1A C9 FF F0 09 A9 0C
5030 20 54 1A C9 FF D0 03 4C C9 18
5040 A5 73 69 05 8D 0D 90 E6 62 A6
5050 8D A9 06 D5 4A D0 03 4C 23 15
5060 A2 FF E0 08 D0 03 4C 23 15 E8
5070 A9 00 D5 56 D0 05 E8 E8 4C C6
5080 13 B5 55 85 86 E8 B5 55 85 87
5090 E8 B4 55 C0 FF D0 15 C8 38 B5
5100 53 E9 16 85 86 95 53 B5 54 E9
5110 00 85 87 95 54 4C 46 14 88 C0
5120 FF D0 07 A9 00 95 54 4C C6 13
5130 94 55 0A 48 EA EA EA EA EA A6
5140 8D A9 04 D5 4A D0 03 4C E6 14
5150 A9 02 D5 4A D0 03 4C 89 14 68
5160 AA A5 73 18 69 02 D5 55 D0 14
5170 A0 FF 94 55 C8 18 75 53 95 53
5180 85 86 A9 00 75 54 95 54 85 87
5190 EA EA EA EA EA EA EA EA EA EA
5200 EA EA EA EA EA EA EA EA EA 20
5210 AC 1D C9 20 F0 0A C9 08 D0 03
5220 4C C9 18 4C C6 13 B5 55 C9 FF
5230 D0 04 A9 DC 65 62 8D 0B 90 A9
5240 11 91 86 18 A9 78 65 87 85 87
5250 A9 07 91 86 4C C6 13 68 AA A5
5260 62 C9 05 10 14 C9 00 F0 10 38
5270 B5 53 E9 16 95 53 B5 54 E9 00
5280 95 54 4C B2 14 18 B5 53 69 16
5290 95 53 B5 54 69 00 95 54 B5 53
5300 85 86 B5 54 85 87 20 AC 1D C9
5310 20 F0 0A C9 08 D0 03 4C C9 18
5320 4C C6 13 A9 12 91 86 18 A9 78
5330 65 87 85 87 A9 02 91 86 A5 62
5340 0A 0A 69 C8 8D 0B 90 4C C6 13
5350 68 AA D6 55 B4 55 C0 FF D0 07
5360 A9 00 95 54 4C C6 13 94 55 20
5370 AC 1D C9 20 F0 0A C9 08 D0 03
5380 4C C9 18 4C C6 13 A9 13 91 86
5390 18 A9 78 65 87 85 87 A9 01 91
5400 86 B5 55 69 E9 8D 0B 90 4C C6
5410 13 A2 FF E0 03 F0 72 8A 48 A2
5420 01 20 89 1B 68 AA E8 B5 75 C9
5430 00 D0 04 E8 4C 25 15 18 B5 74
5440 69 16 95 74 85 84 E8 B5 74 69
5450 00 95 74 85 85 A0 00 B1 84 C9
5460 0B F0 18 C9 20 D0 17 A9 0E 91
5470 84 18 A9 78 65 85 85 85 A9 05
5480 91 84 A5 84 8D 0A 90 4C 25 15
5490 A9 00 95 74 B1 84 20 EA 19 C9
5500 00 D0 03 4C 25 15 A0 00 A9 0E
5510 91 84 20 54 1A A0 00 A9 15 91
5520 84 20 EB 1B A9 20 91 84 4C 25
5530 15 20 70 19 E6 4A A6 8D F6 4C
5540 A9 FF D5 4C D0 13 A9 00 95 4A
5550 95 4C F6 4A D6 4E 20 99 1B D5
5560 4E D0 02 F6 4E B5 4A C9 01 F0
5570 03 4C 41 16 A4 00 B6 00 0A 18
5580 65 4A AA 85 00 C9 20 D0 17 A9
5590 00 85 4A A9 04 C5 00 D0 04 A9
5600 00 85 00 A9 05 85 51 E6 00 4C
5610 C6 15 48 A9 02 85 53 20 09 1B
5620 68 A6 62 E0 04 F0 18 C9 17 D0
5630 05 E6 51 4C 0A 16 C9 18 D0 1D
5640 C6 51 91 84 A9 06 91 86 4C 33
5650 18 A2 00 86 62 A9 11 91 84 A9
5660 07 91 86 20 D8 1A 4C 33 18 A6
5670 62 E0 03 D0 08 A9 10 91 84 A9
5680 04 91 86 4C 33 18 A9 0F 91 84
5690 A9 05 91 86 4C 33 18 C9 02 F0
5700 03 4C DB 16 A9 00 C5 4A F0 0A
5710 A9 06 C5 4A D0 0C A9 00 85 4A
5720 A9 06 85 51 A9 07 85 53 A9 02
5730 C5 4A 30 07 E6 51 C6 53 4C 71
5740 16 C6 51 E6 53 20 09 1B A6 62
5750 E0 04 D0 10 38 A5 84 E9 84 85
5760 84 A5 85 E9 00 85 85 4C 9B 16
5770 E0 00 D0 13 38 A5 84 E9 00 85
5780 84 A5 85 E9 00 85 85 20 D8 1A
5790 4C 33 18 E0 07 D0 07 A9 FF 85
5800 62 4C 33 18 20 09 1B A6 62 E0
5810 03 30 03 4C 27 16 4C 33 18 C9
5820 03 F0 03 4C 20 17 A9 00 C5 4A
5830 D0 04 A9 05 85 51 A9 0A C5 4A
5840 D0 04 A9 00 85 4A A9 04 C5 4A
5850 30 05 E6 51 4C E3 16 C6 51 A9
5860 05 85 53 20 09 1B A6 62 E0 04
5870 D0 1A A9 13 91 71 A9 FF 85 62
5880 18 A5 71 85 84 A9 78 65 72 85
5890 85 A9 01 91 84 4C 33 18 20 09
5900 1B A6 62 E0 02 30 03 4C 27 16
5910 E0 01 D0 03 4C 17 16 4C 33 18
5920 C9 04 F0 03 4C 0E 17 A5 4A C9
5930 00 D0 07 A9 0B 85 51 4C 3C 17
5940 C9 06 D0 04 A9 00 85 4A A5 4A
5950 C9 03 30 05 C6 51 4C 49 17 E6
5960 51 A9 04 85 53 20 09 1B A6 62
5970 E0 05 D0 0F A2 00 86 62 A5 71
5980 85 84 A5 72 85 85 20 D8 1A 20
5990 09 1B A5 4A C9 00 D0 03 4C 36
6000 16 C9 04 F0 F9 C9 03 D0 03 4C
6010 2B 16 C9 01 F0 03 4C 33 18 A9
6020 11 91 84 A9 07 91 86 4C 33 18
6030 C9 05 F0 03 4C D9 17 A5 4A C9
6040 00 D0 0B A9 09 85 51 A9 04 85
6050 53 4C AE 17 C9 0E D0 04 A9 00
6060 85 4A A5 4A C9 07 30 07 E6 51
6070 C6 53 4C BF 17 E6 53 C6 51 20
6080 09 1B A6 62 E0 05 D0 07 A9 00
6090 85 62 4C 17 16 E0 02 D0 03 4C
6100 36 16 4C 33 18 A5 4A C9 30 D0
6110 0B A6 8D A9 01 95 4A 95 4C 4C
6120 01 11 A9 03 85 51 A9 02 85 53
6130 20 09 1B A5 4A C9 0A 10 03 4C
6140 33 18 C9 11 30 03 4C 33 18 AA
6150 BD EF 1D AA A9 16 91 84 A9 05
6160 91 86 38 A5 84 E9 16 85 84 85
6170 86 A5 85 E9 00 85 85 18 A5 85
6180 69 78 85 87 CA E0 00 F0 03 4C
6190 0A 18 EA EA EA A4 73 A9 2A 91
6200 71 20 C5 1B 20 70 19 A4 8D B6
6210 4E 20 89 1B A0 00 A2 67 A5 8D
6220 C9 01 F0 04 A0 10 A2 6A A9 F0
6230 35 00 4A 4A 4A 4A 99 16 1E A9
6240 01 99 16 96 C8 A9 0F 35 00 99
6250 16 1E A9 01 99 16 96 C0 05 F0
6260 09 C8 15 F0 05 E8 C8 4C 54 18
6270 A0 09 F8 38 A5 70 E9 01 85 70
6280 A5 6F E9 00 85 6F D8 A2 00 A9
6290 F0 35 6F 4A 4A 4A 4A 99 16 1E
6300 A9 05 99 16 96 C8 A9 0F 35 6F
6310 99 16 1E A9 05 99 16 96 E0 01
6320 F0 05 C8 E8 4C 91 18 A9 00 8D
6330 0C 90 8D 0B 90 8D 0A 90 4C E1
6340 11 18 4C E1 11 20 A6 1B A4 73
6350 A9 15 91 71 C8 91 71 C8 91 71
6360 A9 85 8D 0D 90 A9 0F 85 61 A5
6370 61 8D 0E 90 A2 90 20 89 1B A5
6380 61 C9 00 F0 05 C6 61 4C E1 18
6390 A6 8D D6 64 A5 64 49 FF 85 64
6400 B5 64 C9 00 D0 28 A2 00 BD E9
6410 1D 9D F8 1E A9 01 9D F8 96 E0
6420 08 F0 04 E8 4C 08 19 A9 10 85
6430 54 A5 54 A2 FF 20 89 1B C6 54
6440 A5 54 C9 00 D0 F3 4C 01 11 20
6450 A6 1B A6 8D A9 01 95 4A 95 4C
6460 F6 64 E0 02 D0 02 A2 04 18 F8
6470 A9 50 75 67 95 67 CA A9 00 75
6480 67 95 67 D8 A9 FF 85 52 AA 9A
6490 C6 52 A2 00 20 89 1B A5 52 8D
6500 0F 90 8D 0C 90 C9 08 D0 ED 4C
6510 01 11 A2 FF E0 0B D0 01 60 E8
6520 B5 79 C9 00 D0 05 E8 E8 4C 72
6530 19 F6 7A B4 7A C0 16 D0 09 A9
6540 00 95 79 E8 E8 4C 72 19 B5 78
6550 E8 85 84 B5 78 E8 85 85 B1 84
6560 C9 0C F0 ED C9 20 D0 19 A9 0D
6570 91 84 18 A9 78 65 85 85 85 A9
6580 01 91 84 B5 78 69 D0 8D 0C 90
6590 4C 72 19 A9 00 95 77 B1 84 20
6600 EA 19 C9 00 D0 03 4C 72 19 A9
6610 0D B4 78 91 84 20 54 1A B4 78
6620 A9 15 91 84 20 EB 1B A9 20 91
6630 84 4C 72 19 A8 8A 48 A9 00 A6
6640 8D C0 17 F0 08 C0 18 F0 04 C0
6650 19 D0 05 68 AA A9 00 60 C0 0F
6660 D0 11 18 F8 A9 25 65 70 85 70
6670 A9 00 65 6F 85 6F D8 A9 10 C0
6680 16 D0 04 EA 4C 31 19 C0 13 D0
6690 05 68 AA A9 00 60 C0 10 D0 02
6700 A9 95 C0 11 D0 02 A9 50 E8 E8
6710 E0 04 D0 02 E8 E8 18 F8 75 66
6720 95 66 CA A9 00 75 66 95 66 CA
6730 A9 00 75 66 95 66 D8 68 AA 60
6740 A8 8A 48 98 A2 FF E0 08 F0 46
6750 E8 48 B5 55 85 86 E8 B5 55 85
6760 87 E8 B4 55 C0 FF D0 01 C8 A9
6770 00 C5 87 D0 04 68 4C 5A 1A 68
6780 D1 86 D0 DA C9 0B F0 23 C9 0C
6790 F0 1F A9 00 95 54 A6 8D E0 E0
6800 03 D0 02 E8 E8 18 F8 A9 01 75
6810 66 95 66 A9 00 75 65 95 65 D8
6820 68 AA 60 68 A9 FF 60 5A 1A 68
6830 AA A9 FF 60 A4 73 A9 0A 91 71
6840 18 A5 71 85 86 A5 72 69 78 85
6850 87 A9 07 91 86 C8 A9 0B 91 71
6860 A9 03 91 86 C8 91 86 A9 0C 91
6870 71 60 A2 FF E0 0B D0 01 60 E8
6880 A9 00 D5 56 D0 0D A5 84 95 55
6890 A5 85 95 56 A9 15 95 57 60 E8
6900 E8 4C DA 1A A9 00 8D 0E 90 A5
6910 C5 C9 27 D0 FA A5 0F 8D 0E 90
6920 60 A9 2C 85 84 85 86 A9 1E 85
6930 85 A9 96 85 87 A0 15 A6 53 E0
6940 00 F0 1B 20 6A 1B 18 A5 84 69
6950 16 85 84 85 86 A5 85 69 00 85
6960 85 18 69 78 85 87 CA 4C 1B 1B
6970 A9 E4 85 84 85 86 A9 1F 85 85
6980 A9 97 85 87 A6 51 E0 00 F0 1B
6990 20 6A 1B 38 A5 84 E9 16 85 84
7000 85 86 A5 85 E9 00 85 85 18 69
7010 78 85 87 CA 4C 4A 1B 60 A9 19
7020 91 84 8A 48 A9 07 A6 8D 38 F5
7030 4A 91 86 68 AA 60 B5 67 85 8A
7040 B5 68 85 8B B5 69 85 8C 60 A0
7050 90 88 EA EA C0 00 D0 F9 CA E0
7060 00 D0 F2 60 60 A9 00 85 62 85
7070 56 85 59 85 5C 85 5F 60 A9 00
7080 8D 0D 90 8D 0C 90 8D 0B 90 8D
7090 0A 90 60 A9 16 85 52 20 68 1D
7100 C6 52 A9 00 C5 52 D0 F5 60 A2
7110 FF E0 08 D0 01 60 E8 B5 79 C9
7120 00 D0 05 E8 E8 4C C7 1B B5 78
7130 85 84 E8 B5 78 85 85 E8 B4 78
7140 A9 20 91 84 4C C7 1B A9 FF 85
7150 52 C6 52 A5 52 8D 0D 90 EA EA
7160 EA EA EA C9 78 D0 F0 60 7E 42
7170 42 42 42 42 42 7E 00 18 28 08
7180 08 08 08 3E 7E 42 02 02 7E 40
7190 42 7E 7E 42 02 02 3E 02 42 7E
7200 08 18 28 48 7E 08 08 08 7E 42
7210 40 40 7E 02 42 7E 7E 42 40 40
7220 7E 42 42 7E 7E 42 02 04 08 10
7230 20 40 7E 42 42 42 7E 42 42 7E
7240 7E 42 42 42 7E 02 42 7E 00 00
7250 0A 14 0A 14 0A 00 E0 30 1F 7E
7260 7E 7F 1F FF 00 00 E0 70 3F F0
7270 E0 00 00 00 00 04 7E 04 00 00
7280 3C 18 3C 3C 3C 3C 18 00 3C 42
7290 DF C3 5E 24 7E 81 18 7E E7 C3
7300 FF 7E 42 C3 18 18 18 3C 66 7E
7310 66 42 18 7E AB D5 AB D5 7E 18
7320 08 30 40 D5 EA 40 30 08 07 0C
7330 18 FC FC 18 0C 07 24 00 99 24
7340 24 99 00 24 3C 42 A5 99 99 A5
7350 42 3C 01 03 07 0F 1F 3F 7F FF
7360 80 C0 E0 F0 F8 FC FE FF FF FF
7370 FF FF FF FF FF FF 3C 42 42 42
7380 7E 42 42 42 7C 42 42 42 5C 42
7390 42 7C 7E 42 40 40 40 40 42 7E
7400 78 44 42 42 42 42 44 78 7E 42
7410 40 40 7C 40 42 7E 7E 42 40 40
7420 5E 42 42 7E 00 00 00 00 00 00
7430 00 00 42 42 42 42 7E 42 42 42
7440 3E 2A 08 08 08 08 2A 3E 40 40
7450 40 40 40 40 40 7E 42 66 5A 5A
7460 42 42 42 42 7E 42 42 42 7E 40
7470 40 40 7C 42 42 42 7C 42 42 42
7480 42 42 42 42 42 42 24 18 42 42
7490 42 42 42 42 42 3C 42 42 42 42
7500 7E 18 18 18 00 00 04 0E 0E 0E
7510 04 00 9F D9 B8 9F 01 01 FF FF
7520 E0 90 D7 95 F5 1D 07 00 A9 2C
7530 85 84 85 86 A9 1E 85 85 A9 96
7540 85 87 A2 00 A0 00 C8 B1 84 88
7550 91 84 C8 B1 86 88 91 86 C8 C0
7560 15 D0 EF A9 20 91 84 E8 E0 15
7570 D0 01 60 A5 84 18 69 16 85 84
7580 85 86 A5 85 69 00 85 85 18 69
7590 78 85 87 4C 78 1D B1 86 C9 20
7600 D0 01 60 C9 0B D0 01 60 C9 0C
7610 D0 03 A9 08 60 A9 15 91 86 20
7620 EB 1B A9 20 91 86 A9 00 95 54
7630 60 EA 2B 05 1C 26 1A 24 20 02
7640 00 2C 21 22 1F 21 25 23 1A 29
7650 25 23 1A 29 1E 26 20 1F 1A 24
7660 1E 20 00 27 1E 26 28 25 26 1E
7670 1A 1D 29 07 08 09 0A 09 08 2F
```

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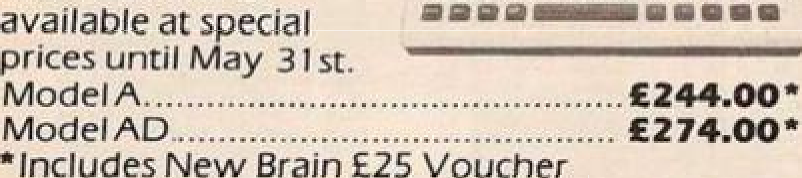
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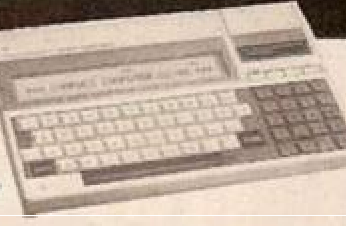
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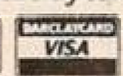
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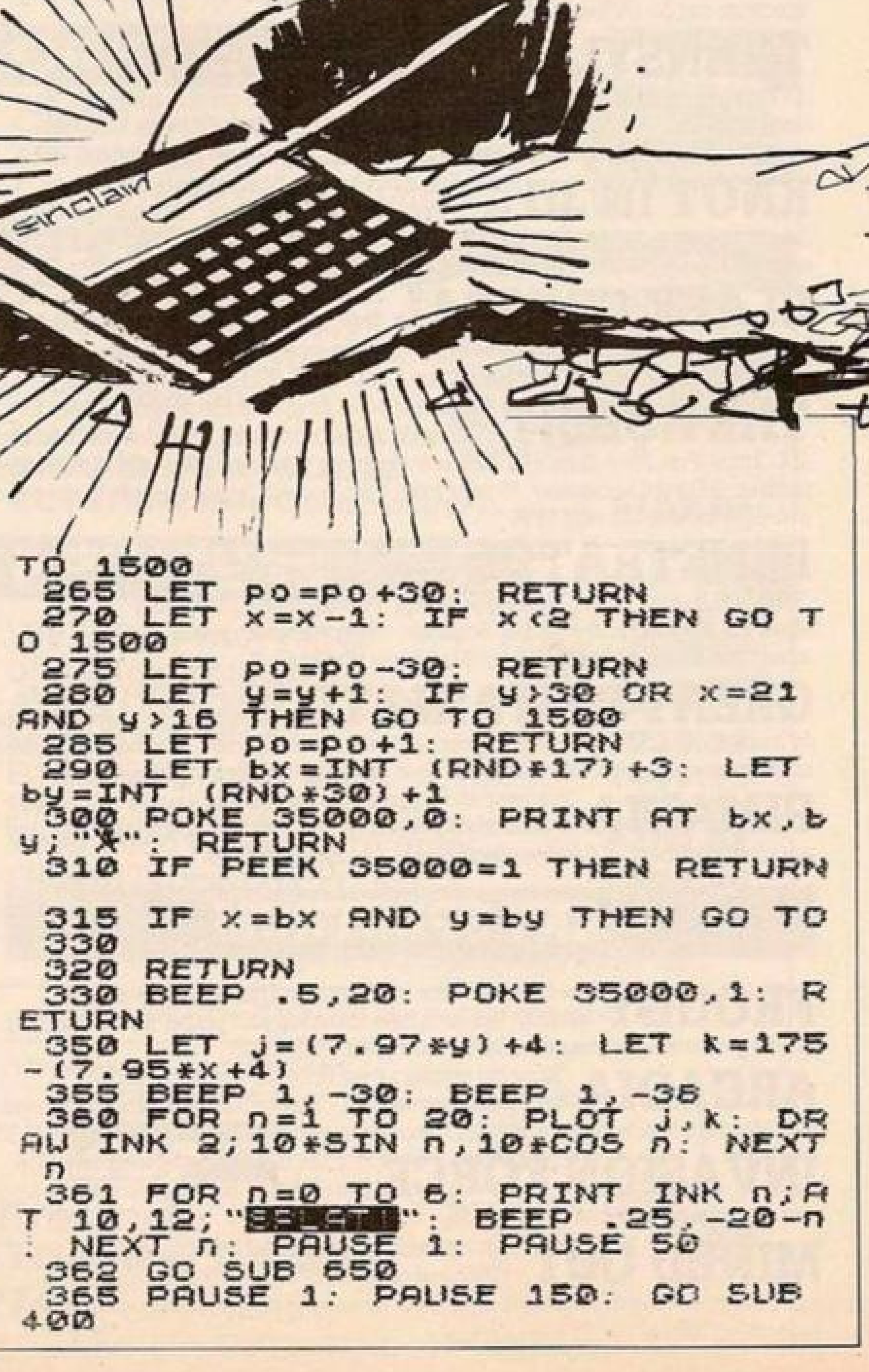
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SPECTRUM MINEFIELD

```
  10 FOR n=144 TO 148 : FOR f=0
TO 7
  20 READ a: POKE USR (CHR$ n)+f
,a: NEXT f: NEXT n
  30 DATA 0,0,0,60,126,255,255,0
  40 DATA 126,255,189,189,255,25
5,231,231
  50 DATA 0,28,36,66,66,165,90,6
0
  60 DATA 24,60,126,60,255,255,1
02,102
  70 DATA 156,92,40,31,28,36,66
  80 PRINT INK 0;;AT 10,4;"DO YO
U WANT TO SEE"'" THE INSTRUCTIO
NS?(Y/N)"
  82 PAUSE 1: PAUSE 0: IF INKEY$
="y" THEN GO SUB 1000
  83 INPUT "LEVEL?(1-9)";d
  84 IF d<1 THEN GO TO 83
  85 PRINT AT 14,3;"PLEASE WAIT
A MOMENT"'" WHILE THE MINES ARE
SET UP"
 100 FOR n=33940 TO 34510: POKE
n,0: NEXT n
 115 LET sc=0
 120 LET co=7-d: IF co<4 THEN LE
T co=6
 125 BORDER co: PAPER co: INK 7-
co: CLS
 130 FOR n=0 TO 31: BEEP .005,n:
 PRINT INK 2;AT 1,n;"@": PRINT I
NK 2;AT 21,n;"@": NEXT n
 140 FOR f=1 TO 21: BEEP .005,f:
 PRINT INK 2;AT f,0;"@": PRINT I
NK 2;AT f,31;"@": NEXT f
 150 PRINT PAPER co; INK 1;AT 21
,14;"   ";AT 1,15;" █ "
 160 LET a$="                  < S
AFE AREA >                "
 170 FOR n=1 TO 30: PRINT PAPER
co; INK n/5;AT 20,1;a$(n TO 30);
AT 2,n;a$(16 TO 46-n): BEEP .02,
11-n/3: BEEP .02,n/3: NEXT n
 175 LET po=555: LET co=7-d
 187 REM **SET UP MINES**
 190 FOR n=1 TO 20+(d*2):
LET a= INT (509*RND)+1: POKE
(34000+a),21: NEXT n
 192 LET ma=132: LET q=0:
LET d=d+1: LET x=21: LET
y=15
 193 IF d>4 THEN GO SUB 290
 195 LET m=0: IF co<3 THEN
LET co=6
 200 PRINT INK 1; PAPER 6;
BRIGHT 1;AT x,y;"*"
 205 IF INT (RND*4)=2 THEN
LET mm=1
 207 REM **CHECK FOR ADJACENT MI
NES**
 208 IF PEEK (34000+po)=21 THEN
GO TO 350
 210 IF PEEK (33999+po)=21 THEN
LET m=m+1
 215 IF PEEK (34001+po)=21 THEN
LET m=m+1
 220 IF PEEK (34030+po)=21 THEN
LET m=m+1
 225 IF PEEK (33970+po)=21 THEN
LET m=m+1
 226 PRINT AT x,y; PAPER 6; BRIG
HT 1;" "
 230 LET k$=INKEY$
 231 IF CODE k$<53 OR CODE k$>56
THEN GO TO 238
 232 IF k$<>"" THEN LET ma=ma-1
 233 IF x=2 AND y=16 AND k$="7"
THEN GO TO 600
 234 GO SUB (VAL k$*10)+200
 235 LET q=q+1
 237 POKE 35999+q,VAL k$
 238 PRINT PAPER m; INK 7;AT 0,1
0;m;" ADJACENT MINE ": IF m<>1 T
HEN PRINT PAPER m; INK 7;AT 0,25
;"S"
 240 IF d>4 THEN GO SUB 310
 245 GO TO 195
 247 REM ###MOVEMENT###
 250 LET y=y-1: IF y<1 OR x=21 A
ND y<14 THEN GO TO 1500
 255 LET po=po-1: RETURN
 260 LET x=x+1: IF x>20 THEN GO
TO 1500
 265 LET po=po+30: RETURN
 270 LET x=x-1: IF x<2 THEN GO T
O 1500
 275 LET po=po-30: RETURN
 280 LET y=y+1: IF y>30 OR x=21
AND y>16 THEN GO TO 1500
 285 LET po=po+1: RETURN
 290 LET bx=INT (RND*17)+3: LET
by=INT (RND*30)+1
 300 POKE 35000,0: PRINT AT bx,b
y;"X": RETURN
 310 IF PEEK 35000=1 THEN RETURN

 315 IF x=bx AND y=by THEN GO TO
330
 320 RETURN
 330 BEEP .5,20: POKE 35000,1: R
ETURN
 350 LET j=(7.97*y)+4: LET k=175
-(7.95*x+4)
 355 BEEP 1,-30: BEEP 1,-36
 360 FOR n=1 TO 20: PLOT j,k: DR
AW INK 2;10*SIN n,10*COS n: NEXT
n
 361 FOR n=0 TO 6: PRINT INK n;A
T 10,12;"[illegible]": BEEP .25,-20-n
: NEXT n: PAUSE 1: PAUSE 50
 362 GO SUB 650
 365 PAUSE 1: PAUSE 150: GO SUB
400
```



Is there a way through the minefield? Armed only with a metal detector and nerves of steel, it's your job to find out. David Goodman sows the anti-tank mines.

IN THIS GAME for the 48K Spectrum you play the part of a tank driver trying to make your way across the minefield to headquarters with vital military secrets.

But to arrive in one piece you must first find a safe path through the mines, which naturally you cannot see, by using your mine detector to tell you how many mines are adjacent to you. This game is a good test of your patience and nerve. How long can you go on dodging the mines before you charge straight up the screen and get blown up?

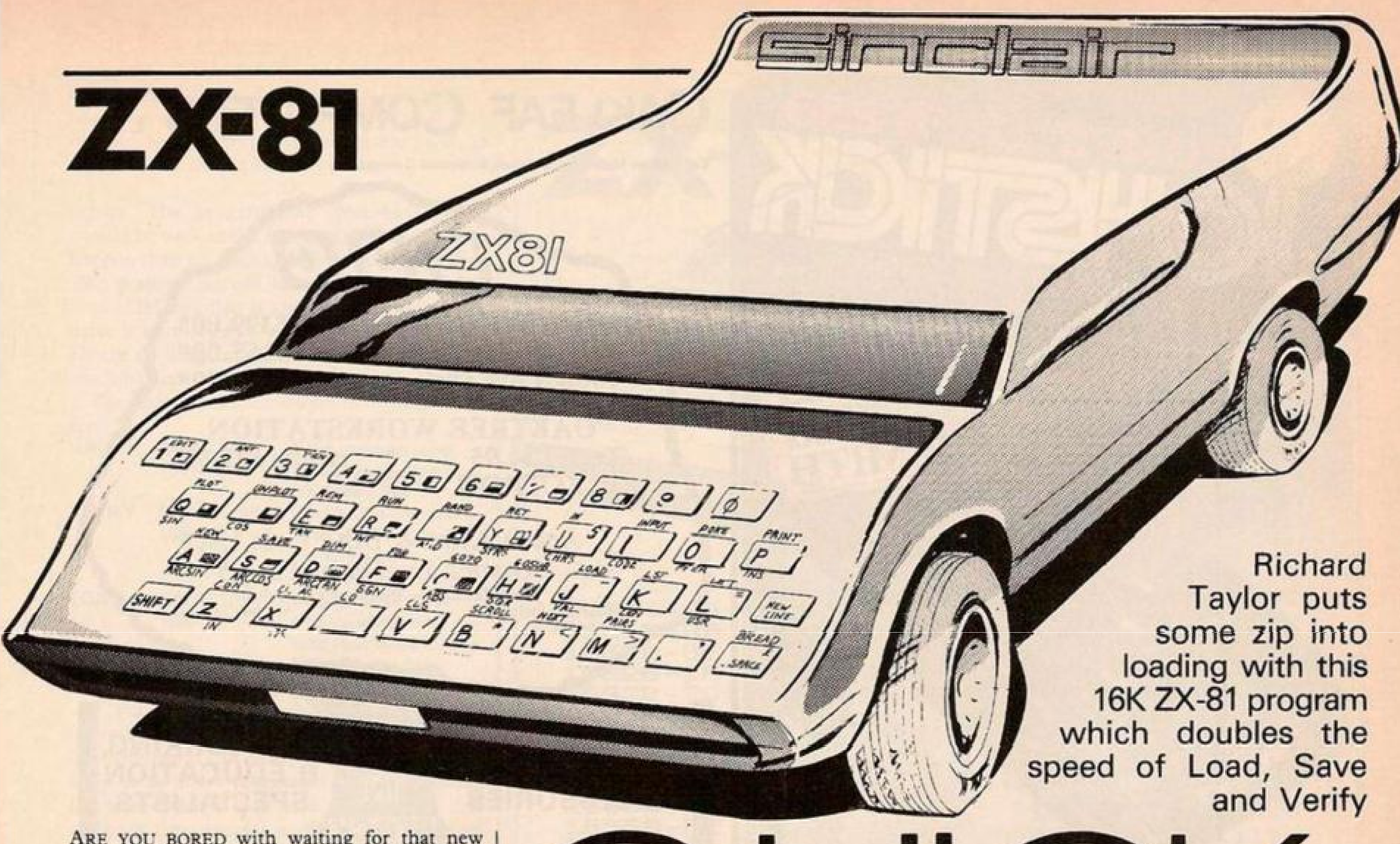
Program notes.

10-70	User-defined graphics
80-85	Beginning: prompt for instructions and level
100-175	Initialisation and print initial screen display
190	Set up mines by Poking 21 into random positions
192-200	Variable and Print tank
208-225	Mine detection
250-285	Movement and check for hitting fence
290-330	Stranded soldier
350-362	Explosion routine
400-470	Action replay
500-615	Success, tune and routine
650-680	Death march
1000-1110	Instruction
1500-1590	Electric fence routine

[graphic]	- graphics A
[graphic]	- graphics B
[graphic]	- graphics C
[graphic]	- graphics D
[graphic]	- graphics E

```
370 PRINT INK 0;AT 10,4;"ANOTHE
R GO?(y/n)": PAUSE 1: PAUSE 0
375 IF INKEY$="n" THEN STOP
380 RUN 83
399 REM ©©© ACTION REPLAY ©©©
400 CLS : FOR n=0 TO 31: PRINT
INK 2;AT 1,n;"[C]": PRINT INK 2;AT
21,n;"[C]": NEXT n
410 FOR f=1 TO 21: PRINT INK 2;
AT f,0;"[C]": PRINT INK 2;AT f,31;
"[C]": NEXT f
415 LET g=0
420 FOR x=3 TO 19: FOR y=1 TO 3
0
430 LET g=g+1: IF PEEK (34000+g
)=21 THEN PRINT INK 0;AT x,y;"[A]"
435 NEXT y: NEXT x
440 PRINT AT 0,10;"ACTION REPLA
Y";AT 0,0;"Score:";sc;AT 1,15;"
 ";AT 21,14;"  "
442 IF d>4 THEN PRINT AT bx,by;
"[E]"
445 LET x=21: LET y=15
450 FOR a=0 TO q-1: LET r=PEEK
(36000+a)
452 IF r=6 AND x<20 THEN LET x=
x+1
453 IF r=7 AND x>2 THEN LET x=x
-1
454 IF r=8 AND y<30 THEN LET y=
y+1
455 IF r=5 AND y>1 THEN LET y=y
-1
457 PRINT INK 1; BRIGHT 1; PAPE
R 6;AT x,y;"[D]"
460 PAUSE 10: PRINT AT x,y; PAP
ER 6; BRIGHT 1;"  "
465 NEXT a
470 GO SUB 650: RETURN
500 FOR f=0 TO 10 STEP 8: RESTO
RE 510: FOR n=0 TO 7: READ a,b
505 BEEP a*2,b+f: NEXT n: NEXT
f
510 DATA .1,0,.05,0,.05,0,.05,5
520 DATA .05,0,.05,5,.25,9,.25,
5
530 RETURN
600 LET d=d+1: LET sc=sc+ma: GO
SUB 500: PRINT AT 0,1;"score:";
sc
610 IF PEEK 35000=1 THEN LET sc
=sc+50: PAUSE 1: PAUSE 150: GO T
O 120
615 PAUSE 1: PAUSE 150: GO TO 1
20
650 RESTORE 670: FOR n=1 TO 11:
READ a,b
660 BEEP a,b: NEXT n: RETURN
670 DATA .5,-3,.55,-3,.2,-3,.65
,-3
680 DATA .5,0,.25,-1,.5,-1,.25,
-3,.5,-3,.25,-4,.75,-3
1000 INK 1: BORDER 6: PAPER 6: C
LS
1005 PRINT AT 1,4;"[C][C][C][C][C][C][C][C][C][C][C][C][C]
[C][C][C][C][C][C][C]"
1010 PRINT AT 2,4;"[C][graphics]
[graphics][C]"
1020 PRINT AT 3,4;"[C][graphics]
[graphics][C]"
1030 PRINT AT 4,4;"[C][graphics]
[graphics][C]"
1040 PRINT AT 5,4;"[C][graphics]
[graphics][C]"
1050 PRINT AT 6,4;"[C][graphics]
[graphics][C]"
1060 PRINT AT 7,2;"[C][C][C]";AT 7,23;
"[C][C][C]"
1080 PRINT AT 8,2;"[C][graphics]
[graphics][C]"
1090 PRINT AT 9,2;"[C][graphics]
[graphics][C]"
1100 PRINT AT 10,2;"[C][graphics]
[graphics][C]"
1110 PRINT AT 11,2;"[C][graphics]
[graphics][C]"
1120 PRINT AT 12,2;"[C][graphics]
[graphics][C]"
1130 PRINT AT 13,2;"[C][C][C][C][C][C][C][C][C][C][C]
[C][C][C][C][C][C][C][C][C][C]"
1140 GO SUB 500
1150 PRINT " The object of this
 game is to get your tank([D]) acr
oss the treacherous minefield,bo
rdered by electrified barbed wir
e;and to take with you vital mil
itary secrets back to base([B]).Ex
tra points can be gained by pick
ing up stranded soldiers([E])."
1155 PRINT AT 0,6;"[illegible]
": PAUSE 1: PAUSE 0
1160 PRINT AT 14,2;"You have a m
ine detector to help you,which w
ill tell you how many mines are
adjacent to you.";
1165 PRINT "You only have one li
fe,and when you are killed an ac
tion replay will show you where
you went wrong.        USE CURSOR KE S
TO MOVE"
1170 PAUSE 1: PAUSE 0: CLS : GO
TO 83
1500 LET j=(7.97*y): LET k=175-(
7.95*x+4)
1510 PLOT j,k
1515 FOR n=0 TO 7: PLOT j,k: BEE
P .001,20: DRAW INK 5;5*COS n-5,
5*SIN n+4: NEXT n
1520 FOR n=0 TO 7: PRINT INK n;A
T 10,7;"[illegible]": PAU
SE 15: NEXT n
1530 GO SUB 650
1540 GO SUB 400
1550 PRINT AT 10,5;"Another Go(Y
/N)": PAUSE 1: PAUSE 0
1560 IF INKEY$="n" THEN STOP
1590 RUN 83
```

ZX-81



Richard Taylor puts some zip into loading with this 16K ZX-81 program which doubles the speed of Load, Save and Verify

QUICK LOAD

ARE YOU BORED with waiting for that new Space Invader program to load? Do you feel like throwing your ZX-81 out of the window when it fails to load the only copy of that new program which took five hours to type in for the third time? If so, then read on. This machine-code program for the 16K ZX-81 allows you to Save, Verify and Load programs at over twice the normal speed with as much, and probably more, reliability. The addition of the Verify facility enables you to be sure that you have transferred the program safely on to tape before you switch off your machine. In short, this program should save a great deal of time, tape and temper.

The machine code is held in a Rem statement at the beginning of the program. Type:

1 REM (256 Xs)

If you have done this properly,

PRINT PEEK 16770

will give 118. The hexadecimal code is shown in listing 1. Type in the hexadecimal loader program shown in listing 2. Now carefully enter the hex code from listing 1. You can enter more than one byte at a time for instance

CDE702

instead of

CD.E7.02

Where . represents a Newline.

When you have finished entering the code, press Newline. The machine will stop with an error report; do not worry about it. Now enter

POKE 16510,0

This changes line 1 into line 0 to protect the machine-code from being deleted by mistake. At this point it is a good idea to make a couple of copies of the program on tape in case the machine crashes. Now check to see if everything is working all right. Enter:

RAND USR 16514

but do not press Newline.

Find a blank part of a cassette, preferably a high quality one. Start the tape recorder recording and press Newline. The program should save in the way it usually does except that the lines should be closer together and more numerous. If this does not happen then you have probably made a mistake in entering the machine code. Re-load the copy of the program you made earlier and type in listing 3. When it is run you can check your code against that shown in listing 1 and correct your mistakes.

Rewind your cassette to the beginning of the high speed recording and type: to verify the recording:

RAND USR 16601 — without Newline

Start the tape and press Newline. The patterns should be the same as when you load a program normally, except the wide bands should be closer together. If this does not happen then check your listing, using the above method. When the recording is finished, the machine should stop with the

0/0

report. It may stop during the recording with an

R/O

error report. This signifies that the tape recording did not exactly match the contents of memory. This is probably due to the volume control being set at the wrong level.

The settings should be the same as for normal loading but sometimes a higher volume level is needed. Just keep altering the volume control and trying again. If it still does not work after a few more tries then it is probably due to something else. It may be because of interference from an outside source, check that the ear and power leads do not cross over one another. Make another recording of the program at high speed and try and Verify that recording. Another cause of problem may be that an error was made in entering the programn, check your listing.

Once the program has verified properly delete all lines except the one containing the machine code. We will now try and load the program back into the machine. Enter

RAND USR 16607

without Newline. Rewind to the beginning of

(continued on page 77)

(continued from page 75)
the program and press play then press the newline key. When the recording has finished the machine should stop with the

0/0

report. The program that you have saved should be back in the machine. If this does not happen then try making another copy on tape. The program should load since if it verifies then it follows that it should load back. Now make a normal copy on tape of the program. Delete all lines except the one containing the machine code before you do this.

The three main functions of Quick Load are:

SAVE	RAND USR 16514	Save program and variables on tape at 650 level.
VERIFY	RAND USR 16601	Check that the contents of the tape are the same as in memory.
LOAD	RAND USR 16607	Delete old program and variables and load new ones in from tape at 650 level.

If you press Break during any of these operations the machine will stop with error D. The command can be used either in program lines or as direct commands, the latter being the most used. If the Save command is in a program then execution of the next program line will occur after the program has loaded. In this way you can have Autorun programs using quick load. To load a program at high speed, the program must contain the machine-code Rem statement itself and the program you wish to save at high speed must not contain any machine code in Rem statements. Use the following method: first, lower RAMtop by entering

POKE 16389,127

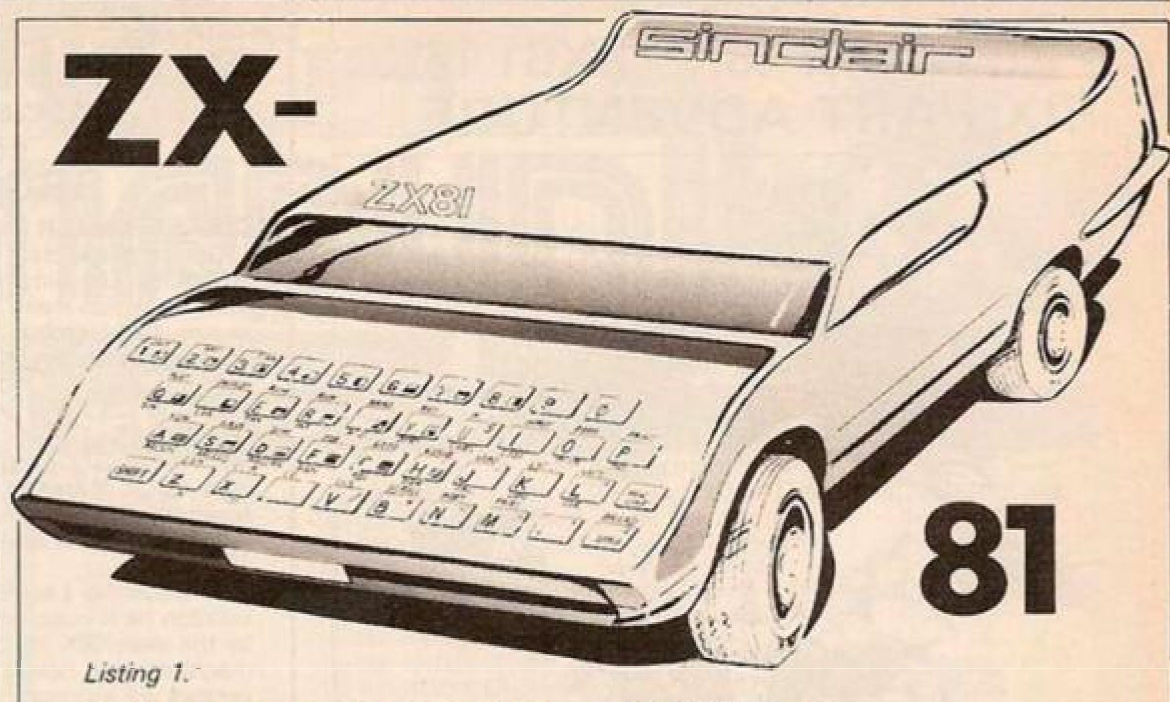
and then New; second, load the quick load program; third, type in listing 4 and run it in fast mode; next, type New; then load the program you wish to use Quick Load on. Now type in line 1 Rem statement followed by 256 xs. Then type in the rest of listing 5 and Run it in Fast mode. Enter

POKE 16510,0

to protect the Rem statment and delete listing 5, lines 10 onwards, finally, Save and Verify it at high speed.

You may have to change the line numbering of the first few lines when you type in listing 5 so that you do not overwrite part of the program. If you intend to use quick load on a program you want to write or type in just load Quick Load before you start.

Unfortunately, you cannot give names to programs saved using Quick Load. Verify and Load work in a similar way to Load quote-quote which acts on the first program it comes to. I would suggest that you use Quick Load in the following way: keep a side of a cassette just for programs saved using Quick Load. Record a copy of Quick load at normal speed. After that are the actual programs saved at high speed. When you want to load a program from the cassette you must first load Quick Load and use its Load command to copy the actual program into memory. Always use verify straight after saving as any change in the program or variable will cause error R to occur when you verify even if the recording is loadable.



Listing 1.

```
16514-CD E7 02 21
16518-A0 0F 10 FE
16522-3E 7F DB FE
16526-1F 30 3D 28
16530-7C B5 20 F2
16534-21 0A 40 4E
16538-37 CB 11 28
16542-21 9F E6 03
16546-C6 02 5F D3
16550-FF 06 22 10
16554-FE 3E 7F DB
16558-FE 1F 30 1C
16562-06 20 10 FE
16566-1D 20 EC 06
16570-6E A7 10 FD
16574-18 DB 23 EB
16578-2A 14 40 37
16582-ED 52 EB 30
16586-CE C3 07 02
16590-3E FF 32 27
16594-40 FD CB 38
16598-86 CF 0C FD
16602-CB 09 CE 18
16606-04 FD CB 09
16610-8E CD E7 02
16614-FD CB 09 86
16618-18 1D 0E 01
16622-06 00 3E 7F
16626-DB FE D3 FF
16630-1F 30 47 17
16634-17 38 67 10
16638-F1 F1 FD CB
16642-09 46 20 49
16646-21 0A 40 11
16650-0F 41 D5 18
16654-DD FD CB 09
16658-C6 FD CB 09
16662-4E 28 04 79
16666-BE 20 38 71
16670-23 EB 2A 14
16674-40 37 ED 52
16678-EB 30 E0 22
16682-14 40 36 76
16686-23 36 7F 23
16690-36 76 23 22
16694-1A 40 22 1C
16698-40 C3 07 02
16702-18 AE FD CB
16706-09 46 28 08
16710-FD CB 09 4E
16714-20 02 C3 E5
16718-03 FD CB 09
16722-4E CA E5 03
16726-CF 1A E5 11
16730-7D 40 B7 ED
16734-52 E1 38 BC
16738-CF 1A 1E 00
16742-06 16 1C DB
16746-FE 17 38 F8
16750-10 F8 7B FE
16754-24 38 C9 FE
16758-5A 3F CB 11
16762-30 C2 C9
```

LISTING 3

```
1000 LET A=16514
1010 PRINT A;"-";
1020 FOR B=A TO A+7
1030 LET C = PEEK B
1040 PRINT CHR$(28+INT
     (C/16));CHR$(28+(C-
     16*INT(C/16)));" ";
1050 NEXT B
1060 LET A=B
1070 GOTO 1010
```

LISTING 2

```
10 LET A=16514
20 LET A$=""
30 IF A$="" THEN INPUT
   A$
40 POKE A,16*CODE A$+
   CODE A$(2)-476
50 SCROLL
60 PRINT A,A$ (TO 2)
70 LET A$=A$(3 TO)
80 LET A=A+1
90 GOTO 30
```

LISTING 4

```
10 FOR A = 0 TO 250
20 POKE 32512+A,PEEK
   (16514+
30 NEXT A
```

LISTING 5

```
0 REM (256 X'S)
10 FOR A =0 TO 250
20 POKE 16514+A,PEEK
   (32512+A)
30 NEXT A
40 STOP
```



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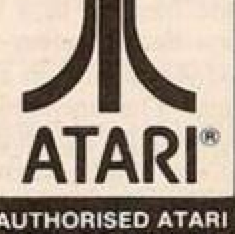
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DISASSEMBLER

Alan Westwood's disassembler turns those tricky chunks of hexadecimal machine-code into easier mnemonics.



VIC-20

MACHINE CODE is a binary code written in memory, each code representing a micro-program written into the processor when it is manufactured. To make it easier for us humans to read, a program can be written to convert this into hexadecimal form. This makes things easier, but is far from ideal. The next step is to substitute mnemonic or assembler code for machine code, and this is the purpose of a disassembler — it translates machine code into mnemonic code. The next step is to a high-level language such as Basic or Forth.

The Vic-20 uses the 6502A microprocessor, a fast version of the 6502 used in the BBC, Pet, and Apple. There are 56 separate mnemonics, and 13 different addressing modes on the 6502 — see figure 1. If you are a beginner in machine code, and you have been following *Your Computer's* series on 6502 machine code, you may find this a handy table to have by your side. Each op-code is represented by a combination of mnemonic and addressing mode. I used this fact to help write the Vic disassembler.

The logic of the system

The main idea was to use the machine-code byte as a pointer to a *two-dimensional array*, each member of the first dimension pointing in turn at the mnemonic code, and each corresponding member of the second dimension pointing at a routine to handle the addressing mode; figure 2 should make this clearer.

However, in order to fit this into an unexpanded Vic, the decode data had to be compacted. So instead of entering the data straight, I used ASCII character codes. Thus each Decode line is represented by two ASCII characters, the first being the mnemonic pointer, and the second the mode pointer. When the disassembler is run further compacting takes place. The two ASCII codes of the data for each decode line are packed into a single member of a one-dimensional integer array. Each member of an integer array is a two-byte variable in a low-byte and high-byte format. The mnemonic pointer is manipulated into the high byte and the mode pointer into the low byte of the corresponding array member. Therefore each op-code is represented by a single array member, and the whole array occupies just over 500 bytes. This process saves approximately 1.5K of memory.

I have written the program in as structured a way as possible in order that it should be easy to add new functions to it. Also all addresses, codes, and operands are printed in hex in order to fit it on the Vic screen. Here, to help you enter it, is a description of the program. Firstly all Rem statements should be left out, as otherwise you may run out of memory when running the disassembler.

Program description

Lines 10-90 load the data into the arrays D%(i) and m$(i) being the decode array and the mnemonic array respectively. In line 16 the strange control character is a shifted-reversed-M. It is not directly available from the keyboard so first type the line with spaces

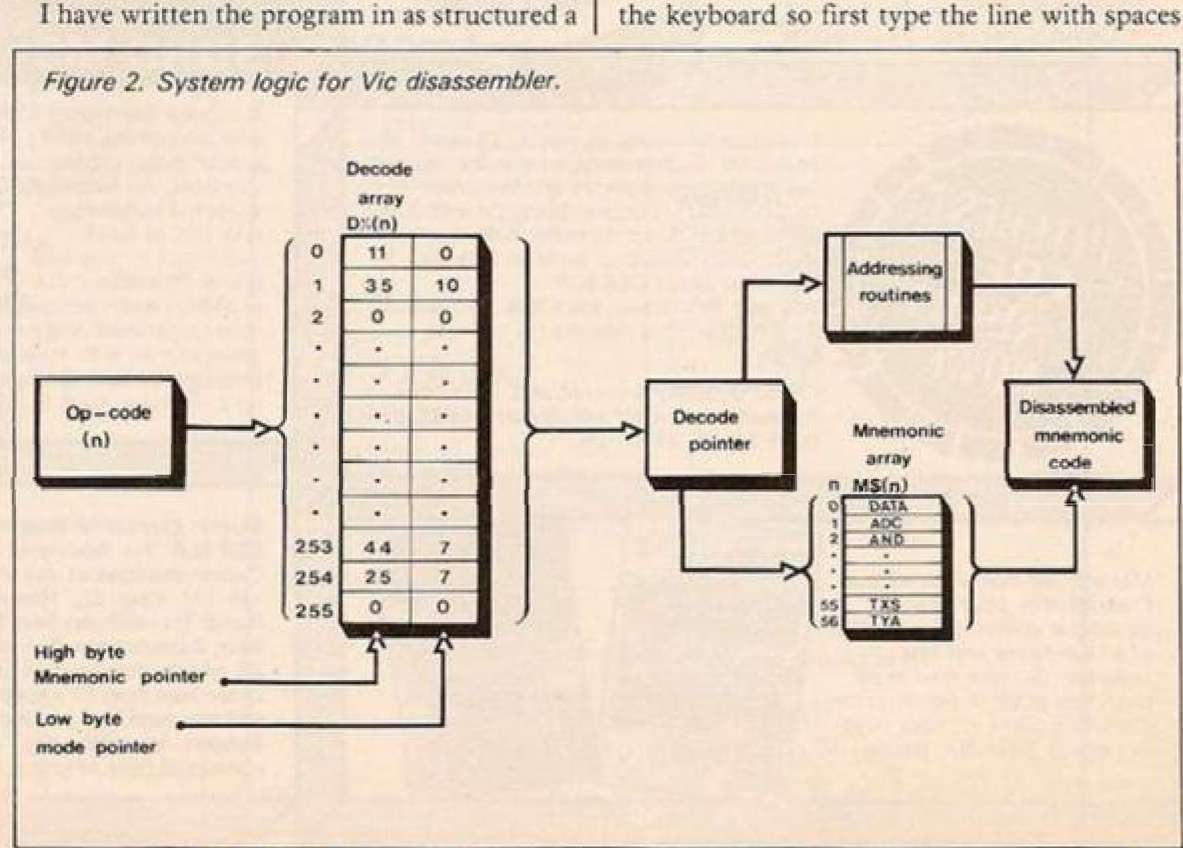


Figure 2. System logic for Vic disassembler.

where it occurs, then go back over the line and type Cntl-Rvs to enter reverse mode then shift-M in the appropriate places. Before you enter the line make sure it is correct as this character affects the listing. It is a very neat trick to know and it saves a lot of cursor control characters.

Line 18 waits for the shift key to be pressed, ignoring all others, including Run/Stop.

Line 60 packs the data into the decode array. A1 is the mnemonic pointer and A2 is the addressing mode pointer. Line 100 is the input line for a new start address for dissassembly. The address must be entered in hex to be correctly interpreted.

Line 120 unpacks the pointers from D%(i), D2-mnemonic pointer, D3-address mode pointer and Line 150 uses D3 to jump to the appropriate address routine. If D3=0 then this line is ignored (implied addressing).

Line 160 prints the dissassembled code, AD$-address, OP$-the actual code, MN$-mnemonic string, TV$-operand string. Lines 170-190 Get the next command from the user. This is where you could put commands to control printer output or a dump to disc, or cassette. Line 2000 is the hex to decimal routine; the decimal to hex routine is at line 1000.

Entering data statements

The decode data statements are at lines 9000-9150. As indicated in the listing the data statements are best entered in lower case mode, as several of the graphic characters are very similar, and would be unreadable from the magazine. Note: the pound is a genuine pound character and not a hash character.

Line 9190 is a checksum: if this does not tally with the total of the data the program will print Data Error and stop. Lines 9210-9260 are mnemonic data; the first mnemonic is Dat and represents op-codes not implemented on the 6502.

Now run the program. It will first print a menu of commands, and then wait for the shift key to be pressed. A short pause will follow and all being well the input prompt

START-ADDRESS ?

will come up on the screen. Now enter 73, and as each dissassembled line comes up, press any key to get the next line. Eventually the screen will look like figure 3, if it does not then you have made a typing error. The program description should help you find the bus. What you should now have dissassembled is the routine used by the Basic interpreter to get the next Basic character. If you have not already saved the program now is the time.

Now you have the program up and running, you will want somewhere to start dissassembly. Figure 4 is a list of addresses of

(continued on page 83)

Figure 4.

FF7F 65405 This is the break — software interrupt — vector's vector.

FF82 65407 Interrupt request, used by the operations system to update the system clock every 0.016 seconds, and to scan the keyboard.

FF8A 65415 Restores all system variables to their default values and also resets the interrupt vectors in RAM.

FF8D 65417 Calling this routine with the carry flag set will put all the RAM vectors into a list starting at an address in the X and Y registers. With the carry clear, it copies a list from an address in the X and Y registers to the system vectors in RAM.

FF99 65433 Called with the carry clear, the X and Y registers will be loaded into the top of memory pointer. With the carry set, it will read the values into the X and Y registers.

FF9C 65436 This is the same as the previous routine, except it changes the bottom of memory pointers.

FF9F 65439 This routine scans the keyboard and the ASCII value of the key will be put into the keyboard buffer.

FFCC 65484 Sets the input-output channels. Keyboard input and Screen is output.

FFD5 65493 If the accumulator is equal to zero Loads RAM from cassette — or any other device. If accumulator equals one, it verifies RAM.

FFD8 65496 Saves RAM from an indirect zero-page address contained in the accumulator up to the address in the X and Y registers on to cassette or disc. Note for this routine and the previous routine to work correctly further routines need to be called.

FFDB 65499 Set the system clock. The accumulator holds the highest byte, X the next byte, Y the lowest byte.

FFE1 65505 Scans the Stop key. If the Stop key is pressed then the zero flag will be set.

FFE4 65512 Gets an ASCII character from the keyboard butter and puts it into the accumulator. If the buffer is empty then the accumulator is equal to zero.

FFEA 65514 Updates the system clock.

FFF0 65520 Sets/Reads the cursor position. If the carry is set, the column position of the cursor is returned in the X register and the line number in the Y register. If the carry is clear then the cursor is moved to the position indicated by the X and Y registers.

Figure 1.

```
Mnemonics
00 DAT   14 CLC   28 JMP   42 RTI   56 TYA
01 ADC   15 CLD   29 JSR   43 RTS
02 AND   16 CLI   30 LDA   44 SBC
03 ASL   17 CLV   31 LDX   45 SEC
04 BCC   18 CMP   32 LDY   46 SED
05 BCS   19 CPX   33 LSR   47 SEI
06 BEQ   20 CPY   34 NOP   48 STA
07 BIT   21 DEC   35 ORA   49 STX
08 BMI   22 DEX   36 PHA   50 STY
09 BNE   23 DEY   37 PHP   51 TAX
10 BPL   24 EOR   38 PLA   52 TAY
11 BRK   25 INC   39 PLP   53 TSX
12 BVC   26 INX   40 ROL   54 TXA
13 BVS   27 INY   41 ROR   55 TXS
Addressing modes
0 implied            7 absolute,x
1 accumulator        8 absolute,y
2 immediate          9 relative
3 zero page         10 (indirect,x)
4 zero page,x       11 (indirect),y
5 zero page,y       12 (indirect absolute)
6 absolute
```

Figure 3.

```
73   E67A     INC7A
75   D002     BNE79
77   E67B     INC7B
79   AD5007   LDA0750
7C   C93A     CMP@3A
7E   B00A     BCS8A
80   C920     CMP@20
82   F0EF     BEQ73
84   38       SEC
85   E930     SBC@30
87   38       SEC
88   E9D0     SBC@D0
8A   60       RTS
```

Branch instructions are printed with their absolute destinations and not their relative offsets. Also the @ character represents immediate addressing. The address in line 4 (0750) will differ depending on the amount of memory expansion.

Disassembler listing.

```
 5 REM VIC-DISSASSEMBLER C.1983 A.WESTWOOD
10 DIMD%(255),M$(56):POKE36879,110
14 REM THE "■" CONTROL CHARACTER IN THE NEXT LINE IS A REVERSED SHIFTED M
15 REM FIRST TYPE A SPACE WHERE THE "■" OCCURS THEN GO OVER AFTER THE LINE HAS
BEEN ENTERED
16 PRINT"■■CONTROL KEYS ARE:-■■F1-START ADDRESS■■F3-DECIMAL TO HEX■■F5-HEX
TO  DECIMAL"
17 PRINT:PRINT"PRESS SHIFT KEY"
18 WAIT653,1
20 PRINT"■LOADING DATA■PLEASE WAIT"
30 FORI=0TO255
40 IFA1$=""THENREADA1$
50 A1=ASC(A1$):A2=ASC(MID$(A1$,2))-48:A3=A3+A2+(A1+((A1>191)*96)-48)
60 D%(I)=(A1+((A1>191)*96)-48)*256+A2
70 A1$=MID$(A1$,3)
80 NEXTI
85 READCS:IFCS<>A3THENPRINT"DATA ERROR":END
90 FORI=0TO56:READM$(I):NEXTI:PRINT"■"
100 INPUT"■■START ADDRESS■■";AD$:H$=AD$:GOSUB2000:AD=D
110 B=PEEK(AD)
120 B1=D%(B):B2=(B1AND(127*256))/256:B3=B1AND255
130 MN$=M$(B2):D=AD:GOSUB1000:AD$=H$
140 TV$="":D=B:GOSUB1000:OP$=H$:AD=AD+1
150 ONB3GOSUB200,300,230,350,400,450,500,550,600,650,700,750
160 PRINTAD$TAB(5)OP$TAB(12)MN$TV$
170 GETG$:IFG$=""THEN170
175 IFG$=CHR$(133)THEN100
180 IFG$=CHR$(134)THENINPUT"■■INPUT DEC■■";D:GOSUB1000:PRINTTAB(10)H$:GOTO170
185 IFG$=CHR$(135)THENINPUT"■■INPUT HEX■■";H$:GOSUB2000:PRINTTAB(10)D:GOTO170
190 GOTO110
200 TV$="A":RETURN
230 GOSUB240:TV$=TE$:RETURN
240 D=PEEK(AD)
250 GOSUB1000:TE$=H$:OP$=OP$+H$:AD=AD+1:RETURN
300 GOSUB240:TV$="■@■"+TE$:RETURN
350 GOSUB240:TV$=TE$+",X":RETURN
400 GOSUB240:TV$=TE$+",Y":RETURN
450 GOSUB240:TV$=TE$:GOSUB240:TV$=TE$+TV$:RETURN
500 GOSUB450:TV$=TV$+",X":RETURN
550 GOSUB450:TV$=TV$+",Y":RETURN
600 AF=PEEK(AD):GOSUB240:AF=(AD-1-(AF<128)*(AF+1)-(AF>127)*(AF-255)):D=AF:
GOSUB1000
```

(continued from page 81)

routines, and a brief description of their functions, found in a section of the ROM called the kernal. When you dissassemble these addresses you will find it to be a jump table. The reason for not jumping directly to the routines is that if the Vic operating system is updated, then although the operating system routines may move in memory, the jump table will not. Therefore, if your machine-code programs use the kernal they will require the minimum of alteration, saving time and effort. This is a common practice in micros and is called indirection. Having said that, here are a few routines you can use profitably from Basic — most of the routines are best called from machine code as they require various flags to be set. The SYS basic command allows the accumulator, X, and Y registers to be passed as paramaters to the machine code routine, by Poking the values into the following addresses: accumulator-780, X-781, Y-782.

A useful facility

The ZX-81 has a Print At instruction and it would be useful if the Vic had this facility so instead of using masses of cursor controls, try the following: Poke 781,line number:Poke 782,,column number:SYS65520 and Print an asterisk. Voila! Print At on the Vic. Or try SYS 59765; this will scroll the screen up one line. Or again Poke 781,line number:Poke 782,21:SYS 60047 will blank that complete line — Poking 782 with other numbers will blank that number of characters. Now you have the tools you can start digging.

(listing continued from page 81)

```
610 TY$=H$:RETURN
650 GOSUB240:TY$="("+TE$+",X)":RETURN
700 GOSUB240:TY$="("+TE$+"),Y":RETURN
750 GOSUB450:TY$="("+TY$+")":RETURN
1000 H$=""
1010 IFDTHENA=INT(D/16):H$=MID$("0123456789ABCDEF",1+D-A*16,1)+H$:D=A:GOTO1010
1020 IFLEN(H$)=3ORLEN(H$)=1THENH$="0"+H$:RETURN
1030 IFH$=""THENH$="00"
1040 RETURN
2000 D=0:IFH$>""THENFORI=1TOLEN(H$):A=ASC(MID$(H$,I,1))-48:D=D*16+A+(A>9)*7:
NEXT :RETURN
2010 RETURN
8000 REM AS SOME OF GRAPHIC CHARACTERS ARE VERY SIMILAR THE DATA STATEMENTS
SHOULD BE ENTERED IN LOWER CASE MODE
8010 REM IN LINES 9040 AND 9060 THE 25TH CHARACTER IS A LOWER CASE L (1).
THE"-" IS A SHIFTED *

8900 rem DECODE DATA
9000 data"!0s!000000s33300u0s2310000s63600"
9010 data":9s!000000s43400>0s8000000s73700"
9020 data"m62!00007323x300w022x1007626x600"
9030 data"892!00000024x400]02800000027x700"
9040 data"z0h!000000h3q300t0h2q10016h6q600"
9050 data"<9h!000000h4q400@0h8000000h7q700"
9060 data"[0f!000000l3y300v012y1001<16y600"
9070 data"=91!000000l4y400+01800000017y700"
9080 data"00-!0000B3-3A300s000F000B6-6A600"
9090 data"49-!0000B4-4A500H0-8G00000-70000"
9100 data"p2n!o200p3n3o300D0n2C000p6n6o600"
9110 data"59n!0000p4n4o500a0n8E000p7n7o800"
9120 data"d2b!0000d3b3e300k0b2f000d6b6e600"
9130 data"99b!000000b4e400?0b8000000b7e700"
9140 data"c2£!0000c3£3i300J0£2r000c6£6i600"
9150 data"69£!000000£4i400↑0£8000000£7i700"
9180 rem CHECKSUM
9190 data4861
9200 rem MNEMONICS
9210 datadat,adc,and,asl,bcc,bcs,beq,bit,bmi,bne,bpl
9220 databrk,bvc,bvs,clc,cld,cli,clv,cmp,cpx,cpy
9230 datadec,dex,dey,eor,inc,inx,iny,jmp,jsr,lda
9240 dataldx,ldy,lsr,nop,ora,pha,php,pla,plp,rol
9250 dataror,rti,rts,sbc,sec,sed,sei,sta,stx,sty
9260 datatax,tay,tsx,txa,txs,tya
```

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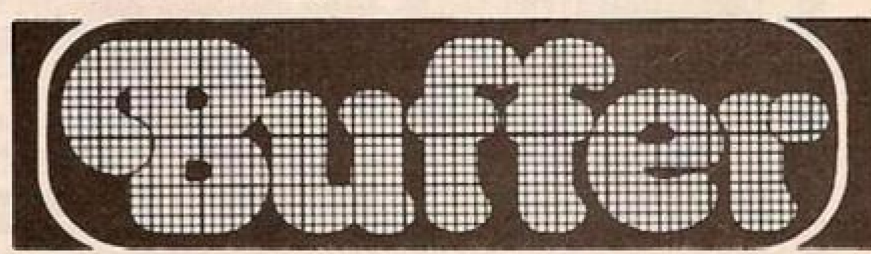
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CLEAR1000,32256

and Load the decimal machine codes, using data statements to Poke them to the correct addresses. Save this as a machine-code tape file. The routines' functions are to paint in the ground, to vibrate the screen display when you are hit, and to print an instant explosion when you hit the enemy aircraft.

Next, Load the Basic. The program uses 30K when running.

Once you have the Basic entered, Save it on tape, and Run the program, which will set the limits of the Basic system, as well as putting the processor into dual clock mode. You will need to type

POKE&HFFD6,0

before using the cassette interface, to revert to normal mode.

Unless you are an experienced aerobatic pilot, I suggest that you start without the additional complication of enemy aircraft. To remove these, alter lines 435, 505 and 2095 of the Basic by editing a Rem into the very beginning of each line. This deactivates them.

On the left-hand joystick up and down control your engine speed, in the range 600-2,500 rpm. Engine speeds below 1,700 slow you down, while above that, they speed you up. Left and right control the rudder. The button gives you an updated instrument reading.

On the right-hand joystick left and right control your ailerons, giving roll, and of course, consequent turn. Do not forget that the horizon appears to go the opposite way to the direction of bank. Up and down control your elevators, and give climb and descent, with loss or gain in airspeed as appropriate. The button gives a map except when there are enemy aircraft about, in which case it fires the guns. I shall give you more details about the map later.

Now for the functions of individual keys. M will give a map at any time, showing the aircraft as a small square, and the runway as a box. The two lines south of the runway are the landing entry zone. Also included is a fuel guage, one of your most vital instruments, as when you run out of fuel, the engine speed drops to 600 and the aircraft flies like a brick.

F is a useful key which puts you back to straight and level at 3,000 feet at a moderate speed. This is a useful panic button if you get really disorientated, but unfortunately is not present on the real thing.

G lowers the undercarriage at speeds below 120 knots. It also raises the undercarriage after take-off.

F lowers the flaps during landing, at speeds below 140 knots. This lowers your stalling speed to 60 knots, but does not affect the stall warning buzzer.

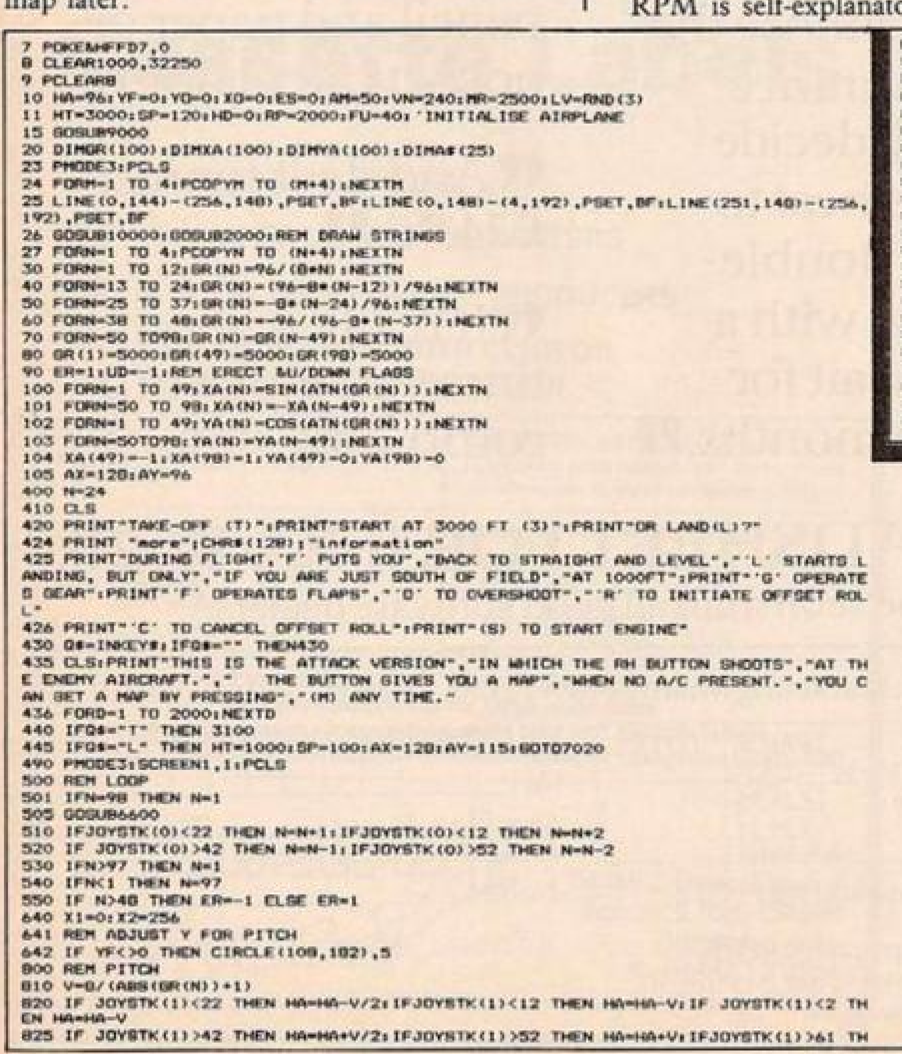
O performs an overshoot on landing, taking you out of the landing routine, and putting you back in free flight. R and C are used as a pair, to initiate and cancel an offset roll respectively. S is used to start the engine before take-off.

Four instruments are shown at the base of the screen: ASI — airspeed, RPM — engine speed — ALT — altimeter — and HDG — heading. These are updated by pressing the left joystick button.

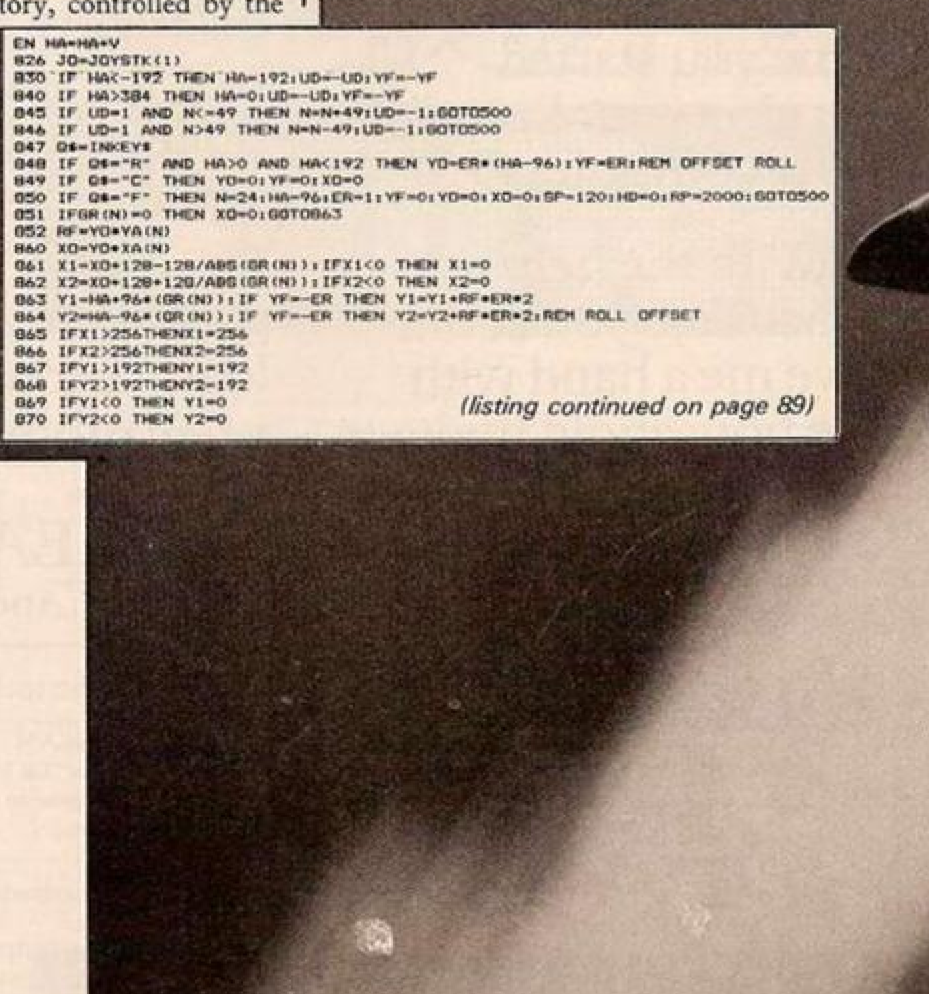
If your ASI drops below 7 on the gauge — 70 knots — you will spin. You must then immediately put the right stick fully forward, and you will recover in a dive. If you are below 2,000 feet you will not recover in time.

You hear a stall warning horn at less than 80 knots. You must watch the upper limit, VNE — velocity never exceed — as, if you exceed this, the wings fall off. This also has a warning whistle at 7 knots below VNE. VNE is usually 240 knots.

RPM is self-explanatory, controlled by the



```
7 POKE&HFFD7,0
8 CLEAR1000,32250
9 PCLEAR8
10 HA=96:YF=0:YO=0:XO=0:ES=0:AM=50:VN=240:MR=2500:LV=RND(3)
11 HT=3000:SP=120:HD=0:RP=2000:FU=40:'INITIALISE AIRPLANE
15 GOSUB9000
20 DIMGR(100):DIMXA(100):DIMYA(100):DIMA$(25)
23 PMODE3:PCLS
24 FORM=1 TO 4:PCOPYM TO (M+4):NEXTM
25 LINE(0,144)-(256,148),PSET,BF:LINE(0,148)-(4,192),PSET,BF:LINE(251,148)-(256,
192),PSET,BF
26 GOSUB10000:GOSUB2000:REM DRAW STRINGS
27 FORN=1 TO 4:PCOPYN TO (N+4):NEXTN
30 FORN=1 TO 12:GR(N)=96/(8*N):NEXTN
40 FORN=13 TO 24:GR(N)=(96-8*(N-12))/96:NEXTN
50 FORN=25 TO 37:GR(N)=-8*(N-24)/96:NEXTN
60 FORN=38 TO 48:GR(N)=-96/(96-8*(N-37)):NEXTN
70 FORN=50 TO98:GR(N)=GR(N-49):NEXTN
80 GR(1)=5000:GR(49)=5000:GR(98)=5000
90 ER=1:UD=-1:REM ERECT &U/DOWN FLAGS
100 FORN=1 TO 49:XA(N)=SIN(ATN(GR(N))):NEXTN
101 FORN=50 TO 98:XA(N)=-XA(N-49):NEXTN
102 FORN=1 TO 49:YA(N)=COS(ATN(GR(N))):NEXTN
103 FORN=50TO98:YA(N)=YA(N-49):NEXTN
104 XA(49)=-1:XA(98)=1:YA(49)=0:YA(98)=0
105 AX=128:AY=96
400 N=24
410 CLS
420 PRINT"TAKE-OFF (T)":PRINT"START AT 3000 FT (3)":PRINT"OR LAND(L)?"
424 PRINT "more";CHR$(128);"information"
425 PRINT"DURING FLIGHT,'F' PUTS YOU","BACK TO STRAIGHT AND LEVEL","'L' STARTS L
ANDING, BUT ONLY","IF YOU ARE JUST SOUTH OF FIELD","AT 1000FT":PRINT"'G' OPERATE
S GEAR":PRINT"'F' OPERATES FLAPS","'O' TO OVERSHOOT","'R' TO INITIATE OFFSET ROL
L"
426 PRINT"'C' TO CANCEL OFFSET ROLL":PRINT"(S) TO START ENGINE"
430 Q$=INKEY$:IFQ$="" THEN430
435 CLS:PRINT"THIS IS THE ATTACK VERSION","IN WHICH THE RH BUTTON SHOOTS","AT TH
E ENEMY AIRCRAFT.","   THE BUTTON GIVES YOU A MAP","WHEN NO A/C PRESENT.","YOU C
AN GET A MAP BY PRESSING","(M) ANY TIME."
436 FORD=1 TO 2000:NEXTD
440 IFQ$="T" THEN 3100
445 IFQ$="L" THEN HT=1000:SP=100:AX=128:AY=115:GOTO7020
490 PMODE3:SCREEN1,1:PCLS
500 REM LOOP
501 IFN=98 THEN N=1
505 GOSUB6600
510 IFJOYSTK(0)<22 THEN N=N+1:IFJOYSTK(0)<12 THEN N=N+2
520 IF JOYSTK(0)>42 THEN N=N-1:IFJOYSTK(0)>52 THEN N=N-2
530 IFN>97 THEN N=1
540 IFN<1 THEN N=97
550 IF N>48 THEN ER=-1 ELSE ER=1
640 X1=0:X2=256
641 REM ADJUST Y FOR PITCH
642 IF YF<>0 THEN CIRCLE(108,182),5
800 REM PITCH
810 V=8/(ABS(GR(N))+1)
820 IF JOYSTK(1)<22 THEN HA=HA-V/2:IFJOYSTK(1)<12 THEN HA=HA-V:IF JOYSTK(1)<2 TH
EN HA=HA-V
825 IF JOYSTK(1)>42 THEN HA=HA+V/2:IFJOYSTK(1)>52 THEN HA=HA+V:IFJOYSTK(1)>61 TH
```



```
EN HA=HA+V
826 JO=JOYSTK(1)
830 IF HA<-192 THEN HA=192:UD=-UD:YF=-YF
840 IF HA>384 THEN HA=0:UD=-UD:YF=-YF
845 IF UD=1 AND N<=49 THEN N=N+49:UD=-1:GOTO500
846 IF UD=1 AND N>49 THEN N=N-49:UD=-1:GOTO500
847 Q$=INKEY$
848 IF Q$="R" AND HA>0 AND HA<192 THEN YO=ER*(HA-96):YF=ER:REM OFFSET ROLL
849 IF Q$="C" THEN YO=0:YF=0:XO=0
850 IF Q$="F" THEN N=24:HA=96:ER=1:YF=0:YO=0:XO=0:SP=120:HD=0:RP=2000:GOTO500
851 IFGR(N)=0 THEN XO=0:GOTO863
852 RF=YO*YA(N)
860 XO=YO*XA(N)
861 X1=XO+128-128/ABS(GR(N)):IFX1<0 THEN X1=0
862 X2=XO+128+128/ABS(GR(N)):IFX2<0 THEN X2=0
863 Y1=HA+96*(GR(N)):IF YF=-ER THEN Y1=Y1+RF*ER*2
864 Y2=HA-96*(GR(N)):IF YF=-ER THEN Y2=Y2+RF*ER*2:REM ROLL OFFSET
865 IFX1>256THENX1=256
866 IFX2>256THENX2=256
867 IFY1>192THENY1=192
868 IFY2>192THENY2=192
869 IFY1<0 THEN Y1=0
870 IFY2<0 THEN Y2=0
```

(listing continued on page 89)



left stick, and has a range of 6–25 multiplied by 100. Higher speeds use more fuel, but climb better, and increase your airspeed.

ALT shows your height in units of 10 feet for take-off and landing, and units of 100 feet for normal flight.

HDG is the bearing on which you are flying, in units of 10 degrees.

The map will show your movements, so flying on a heading of 00, you will go upwards on the map. Note that you can fly right off the map and will then see nothing.

G and F appear at the base. When short black lines are present this indicates that your flaps or gear are down.

You are now ready for take-off. Run the program, and select T on the prompt. You will get a runway display. Put on full power, and press S. The display will start to move.

Press the left button from time to time; it is better not to hold it in as this slows things down. When ASI reaches 60, pull back on the right stick. You will now take off. When the horizon reaches the base of the screen, put the stick back to centre, to maintain the rate of climb. Retract your gear with G. When you reach 500 feet, all the controls and display start to work fully.

Aerobatics are best done at over 2,000 feet, because of the risk of spinning. I cannot teach you to fly, but here are some guidelines.

To roll, put your nose a little above the horizon, speed 140-180, and roll with aileron, the right stick. Support the nose with upgoing rudder — left stick — when the wings are vertical. The program simulates the way the nose drops in the roll quite realistically. To loop; get as much airspeed as you can and then pull hard to lift the nose. Eventually, the ground will reappear, first inverted, then erect, provided you do not stall. Outside loops are also possible: you push forward on the joystick.

Flat turns can be achieved with rudder alone, and combinations of manoeuvres can be achieved, but one special one is the offset roll. This is rolling while climbing or diving. Because of the display method, you must lock the offset by pressing R after setting the rate of climb or descent, and before rolling. When the roll is complete, cancel the offset with C. During the offset roll, you will see a small circle on the instrument panel.

If you do not want the bother of taking off, you can start at 3,000 feet by replying 3 to the initial T, L or 3 prompt.

You can practise landing by replying L to the initial prompt, which will put you on final approach. The more conventional procedure is to place yourself in the area demarcated by the two horizontal lines on the map, at just below 1,000 feet, and on a heading of 330 — 30 degrees, roughly north. If you then press L, you will enter the landing routine. Put your wheels and flaps down — F and G — which will only work if your speed is below 120 and 140 knots, respectively. Control your heading with the rudder to keep the runway central. Descend quickly until you are close to the runway, then round out.

You can only land if your speed is below 90 knots, and the horizon is approximately in the

(continued on page 89)

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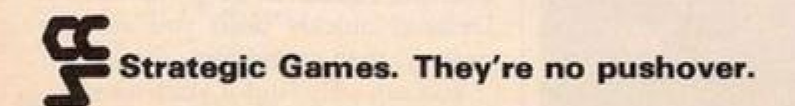


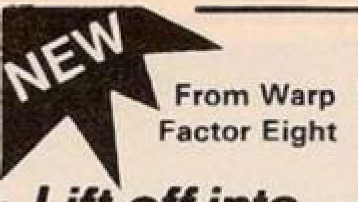
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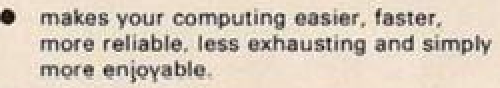






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(continued from page 87)

middle of the screen. If you mess it up, you will get various messages, but you can press O at any time before landing, and go round again.

When you have mastered the aircraft, try taking on some enemy planes. Reactivate the three lines — 435, 505, 2095 — and Run.

As soon as you have left the take-off display, an enemy aircraft will appear after a random time, heralded by a beep. He is flying at 160 knots, and will get larger if you catch him up. He dodges, again randomly, and fires off salvoes of four rockets at you, which stay on the screen for a time proportional to the distance between you and him. At the moment these rockets leave the screen, if they are within your gunsight, you will be hit, and receive a damage or "bale out" report. Baling out is automatic, accompanied by a spectacular display.

You can interrupt the program with Break at any time, and restart with Goto12000. If you have done any editing, however, you must use Run, as editing clears all the variable arrays, and Run resets them.

The alterations shown at the end of the main program will make the Dragon Flight Simulator controllable from the keyboard. The simulator is a little harder to fly, although still quite usable. It was necessary to make the elevator, aileron and rudder controls self-centring, as, with no stick to indicate the current settings, one soon becomes very confused.

The instructions need some modification, which I have built into the display screens at the beginning of the program. The main differences are that the aircraft joystick — previously the right-hand joystick — is now controlled by the arrow keys, operating as you would expect — the joystick forward function is now performed by the up arrow. The other control alterations are explained in the listing.

You have to keep pressing S to keep turning to the right. Similarly with the arrow-keys you have to keep pressing the up-arrow to keep pitching up, when doing a loop. If you want to alter the pitch rate, this can be achieved by altering 820 and 825. Try altering HA by

+/-2*V

per key press, if you find the pitch too sluggish. The joystick version gives three different pitch rates according to stick deflection. You will also have to be quick to reduce your rpm when entering the landing routine, or you will overshoot.

I would be happy to oblige readers by supplying taped copies of the joystick or keyboard version of the program, for the sum of £4.85, including postage and packing. Write to J R G Nash, 30 Hutchcome Road, Botley, Oxford OX2 9HL.

(listing continued from page 8)

```
871 IFX1>256THENX1=256
872 IFX2>256THENX2=256
873 IFX1<0THENX1=0
874 IFX2<0THENX2=0
901 IFX1<0 ANDX2<0 OR X1>256 AND X2>256 THEN PCLS:GOTO 500
910 REMUPDATE INSTRUMENTS
915 RU=JOYSTK(2)
920 RP=2500-(30*JOYSTK(3)):IF RP>MR THEN RP=MR
925 FU=FU-RP*35/(1800*1800)
926 IF FU<=0 THEN RP=600
930 HT=HT-(96-HA)/8
935 IF HT<10 THEN GOTO5800
940 SP=SP-ER*(HA-96)/10+(RP-1700)/80:IFER=-YF THEN SP=SP-Y0/5
943 IF SP>140 THEN SP=SP-(SP-140)/12.5:REM AERODYNAMIC DRAG
945 IFSP>(VN-7) THEN GOSUB6500:REM VNE WARNING
950 IFSP<80 THEN GOSUB4000:REM STALL WARNING
955 IFSP>VN THEN GOTO5500:REM VNE
960 IF SP<70 THEN GOTO5000:REM SPIN
963 REM NOSE DROPPING IN ROLL
964 HA=HA-6*ER*ABS(XA(N))-((RU-32)/4)*SGN(GR(N))
970 HD=HD+XA(N)*ER*8:HD=HD+(RU-32)*8*ABS(YA(N))*ER/32:IFHD>359 THEN HD=HD-359
971 IFHD<0 THEN HD=HD+360
974 AX=AX+SIN(HD/57)*SP/720:AY=AY+COS((HD+180)/57)*SP/720
975 PE=PEEK(65280):IF(PE=126 OR PE=254) AND AM>0 ANDAF=1 THEN GOSUB8500
976 IFPE=126 OR PE=254 THEN GOSUB6000
980 PE=PEEK(65280):IFPE=125 OR PE=253 THEN GOSUB3000
985 IFQ$="M" THEN GOSUB6000
990 IF Q$="L" THEN GOTO 7000
991 Q$=""
998 PCOPY 8 TO4:PCOPY 7 TO3:PCOPY 6 TO 2:PCOPY 5 TO 1:IFY1<=0 AND Y2<=0 THEN GOT
O 1015
999 IF  Y1>=192 AND Y2>=192 THEN1016
1000 LINE(X1,Y1)-(X2,Y2),PSET
1010 REM M/C PAINT ROUTINES
1015 IFY1<=0 AND Y2<=0 AND ER=1 THEN POKE32766,6:POKE32767,0:POKE32762,24:POKE32
763,0:EXEC32256:GOTO1490
1016 IFY1>=192 AND Y2>=192 AND ER=-1 THEN POKE32766,6:POKE32767,0:POKE32762,24:P
OKE32763,0:EXEC32256:GOTO1490
1020 IFER=-1 AND Y1>=Y2 THENPOKE(32766),6:POKE(32767),0:POKE(32762),6+(Y1-3)*32/
256:POKE(32763),0:EXEC32256
1030 IFER=1 AND Y1<Y2 THEN POKE(32766),6+(Y1+4)*32/256:POKE(32767),0:POKE(32762)
,24:POKE(32763),0:EXEC32256
1040 IFER=-1 AND Y1<Y2 THEN POKE(32766),6:POKE(32767),31:POKE(32762),6+(Y2-3)*32
/256:POKE(32763),0:EXEC32303
1050 IFER=1 AND Y1>=Y2 THEN POKE(32766),6+(Y2+3)*32/256:POKE(32767),127:POKE(327
62),24:POKE(32763),31:EXEC32303
1490 IF UD=1 THEN UD=-1
1500 GOTO500
2000 REM SET UP GAUGES
2010 P=INT(SP/100):Q=INT((SP-100*P)/10):P=P+10:Q=Q+10
2020 S$=A$(P)+A$(Q)
2030 P=INT(RP/1000):Q=INT((RP-1000*P)/100):P=P+10:Q=Q+10
2040 R$=A$(P)+A$(Q)
2050 P=INT(HT/1000):Q=INT((HT-1000*P)/100):P=P+10:Q=Q+10
2060 H$=A$(P)+A$(Q)
2070 P=INT(HD/100):Q=INT((HD-100*P)/10):P=P+10:Q=Q+10
2080 D$=A$(P)+A$(Q)
2090 DRAW "BM18,176;S12"
2095 CIRCLE(128,96),7
2100 DRAWS$
2110 DRAW"BM68,176"
2120 DRAWR$
2130 DRAW"BM126,176"
2140 DRAWH$
2150 DRAW"BM188,176"
2160 DRAWD$
2200 RETURN
3000 REM UPDATE DIALS
3010 PCLS:GOSUB2000
3020 LINE(0,144)-(256,148),PSET,BF:LINE(0,148)-(4,192),PSET,BF:LINE(251,148)-(25
6,192),PSET,BF
3030 GOSUB10034
3040 PCOPY4 TO 8
3050 RETURN
3100 REM TAKE OFF
3101 UC=1:GF=1:SP=0:HT=0:RP=0:HD=0:EF=0
3102 AM=50:REM AMMO
3110 HA=96:X1=0:X2=256
3130 GOSUB3000
3190 FORM=1 TO 4:PCOPY(M+4) TO M:NEXTM
3200 LINE(0,HA)-(256,HA),PSET
3210 LINE(X1,192)-(96,HA),PSET
3220 LINE(160,HA)-(X2,192),PSET
3225 IFUC=1 THEN FOR U=163 TO 170:PSET(U,192,8):NEXTU
3230 IFGF=1 THEN LINE(128,96)-(128,144),PSET
3231 GF=-GF:IFGF=-1 THEN LINE(128,96)-(128,144),PRESET
3300 SCREEN1,1
3310 IF INKEY$="S" THEN EF=1:GOTO3312
3311 IF EF=0 THEN GOTO 3310
3312 JO=JOYSTK(0):JO=JOYSTK(1):JP=JOYSTK(2)
3315 RP=2500-(30*(JOYSTK(3)))
3316 FU=FU-RP*35/(1800*1800)
3317 AY=AY-SP/720:IFAY<86 AND HT<10THEN CLS:PRINT "YOU RAN OVER THE END OF THE R
UNWAY":GOTO12000
3318 IFFU<=0 THEN RP=600
3319 SP=SP+(RP-1700)/200:IFSP<0 THEN SP=0:EF=0
3320 DE=400/(SP+.1):FORD=1 TO DE:NEXTD
3330 PE=PEEK(65280):IFPE=125 OR PE=253 THEN HT=HT*10:GOSUB3000:HT=HT/10
3335 IFPE=126 OR PE=254 THEN GOSUB 6000
3340 IFUC=0 AND SP<80 AND HT<=2 THEN CLS:PRINT"YOU RETRACTED THE UNDERCARRIAGE",
"TOO SOON, AND CRASHED":GOTO12000
3400 REM TAKE OFF
3403 Q$=INKEY$:IF Q$="G" THEN UC=0
3405 IF SP>85  THEN GF=0: CANCEL FLASHING LINE
3410 IF GF=0 THEN 3420 ELSE 3900
3420 IFJO>42 THEN HA=HA+4:IFJO>52 THEN HA=HA+8
3425 IFJO<22 AND HT>10 THENHA=HA-4:IFJO<12 THEN HA=HA-8
3430 HT=HT-(96-HA)/8:IFHT<0 THEN HT=0
3432 IF HT<=2 AND SP<70 THEN GF=1
3435 IF HA<94 AND HT>10 THEN GOTO7030
3440 SP=SP-(HA-96)/10+(RP-1700)/100+2*(UC=1)
3460 IFSP<80 AND HT>10 THEN GOSUB4000
3465 IFSP<70 AND HT>10 THEN 5000:REM SPIN
3470 FORM=1 TO 4:PCOPY(M+4)TO M:NEXTM
3480 IF HA>192 THEN HA=192
3485 IFHA<0THEN HA=0
3490 IF HT>500 THEN GOTO 500
3500 IFSP>225 THEN GOTO 5500
3510 REM RESET X VALUES OF RUNWAY
3520 X1=96*HT/500:X2=256-(96*HT/500)
3900 GOTO3200
4000 SOUND100,5
4005 SP=SP+2
4010 RETURN
5000 REM SPIN & MAYBE RECOVER
5005 SC=0
5010 FORN=5 TO 8:FORD=1 TO 300:NEXTD:PCLS(N):NEXTN
5020 D=JOYSTK(0):IF JOYSTK(1)<4 AND HT>2000 THEN N=24:HA=8:SP=100:YF=0:Y0=0:X0=0
: GOTO 500
5030 SC=SC+1:IFSC>4 THEN PCLS4:SCREEN0,0:CLS:PRINT@256, "YOU SPUN INTO THE GROUN
D":GOTO 12000
5040 GOTO 5010
5500 PCLS4:FOR D=1 TO 1200:NEXTD
5510 SCREEN 0,0:CLS:PRINT@256,"YOU EXCEEDED VNE":PRINT:PRINT"FLUTTER DEVELOPED":
PRINT:PRINT"AND THE WINGS FELL OFF"
5520 GOTO12000
5800 PCLS4:SCREEN0,0:CLS:PRINT@256,"YOU CRASHED INTO THE GROUND":PRINT:PRINT"AT
";SP;"  KNOTS":GOTO12000
6000 REM MAP
6005 IF HT<10 THEN RETURN
6010 PCLS
6015 IFAX<0 OR AX>256 ORAY<0 OR AY>192 THEN 6040
6020 LINE(124,86)-(132,106),PSET,B
6025 LINE(124,110)-(132,110),PSET
6026 LINE(124,120)-(132,120),PSET
6030 LINE(AX,AY)-(AX+4,AY+4),PSET,BF
6035 LINE(108,182)-(148,192),PSET,B:LINE(108,182)-((108+FU),192),PSET,BF
6036 DRAW"BM110,170;S8"
6037 DRAW F$
6040 SCREEN1,1:FORD=1 TO 1500:NEXTD
6050 RETURN
6500 REM VNE WARNING
6510 SOUND200,5:SP=SP-2
6520 RETURN
6600 REM ENEMY A/C ATTACK
6610 IFAF=1 THEN 6652
6620 RX=RND(30):IF RX>29 THEN AF=1:ED=1000:SOUND50,2:LM=RND(2)
6630 IF AF=0 THEN RETURN
6640 EH=RND(80)-40
6650 EA=RND(72)-36:REM ENEMY ALTITUDE
6652 RE=RND(12):IF RE<12 THEN 6659:REM ALTER COURSE EVERY 12 TIMES
6655 RX=RND(10)
6659 IFRX=0 THEN 6700
6660 IFRX=7 THEN EH=EH+3
6665 IFRX=8 THEN EH=EH-3
6670 IFRX=9 THEN EA=EA+3
6675 IFRX=10 THEN EA=EA-3:REM ENEMY MOVEMENTS
6700 TH=HD:IF HD>180 THEN TH=HD-360
6710 EX=128+EH-TH
6720 TY=HA-96:
6730 EY=96+TY-EA
6740 ED=ED-(SP-160)*.375:IFED<80 THEN ED=80:REM ENEMY DISTANCE
6750 EL=2000/ED:EU=500/ED
6753 IF BF=1 THEN 6756
6755 RB=RND(10):CY=INT(ED/200):IFRB<10 THEN 6790
6756 IFEY>186 THEN EY=186
6757 IFEX<11 THEN EX=11
6758 IFEX>245 THEN EX=245
6759 IFEY<6 THEN EY=6
6760 BX(1)=EX-10:BY(1)=EY-5:BX(2)=EX+10:BY(2)=EY-5:BX(3)=EX-10:BY(3)=EY+5:BX(4)=
EX+10:BY(4)=EY+5:BF=1
6770 FORZ=1 TO 4:PSET(BX(Z),BY(Z),8):NEXTZ
6780 CY=CY-1:IFCY<1 THEN BF=0
6790 IF (EX-EL)<1 OR (EX+EL)>255 OR (EY-EU)<1 OR (EY+EU)>191 THEN 6999
6795 COLOR6,5
6800 LINE((EX-EL),EY)-((EX+EL),EY),PSET:LINE(EX,EY)-(EX,(EY-EU)),PSET:LINE((EX-E
U),(EY-EU))-((EX+EU),(EY-EU)),PSET
6805 COLOR8,5
6810 REM TEST FOR HIT ON YOUR PLANE
6815 IFCY<>0 THEN 6999
6819 Z=1
6820 IF BX(Z)>124 AND BX(Z)<132 AND BY(Z)>92 AND BY(Z)<100 THEN GOTO 9200
6821 Z=Z+1:IFZ<5 THEN 6820
6999 RETURN
7000 REM LANDING
7010 IF AX>124 AND AX <132 AND AY >110 AND AY<120 AND ABS(HD-180)>150 AND HT<100
1 THEN 7020 ELSE 998
```

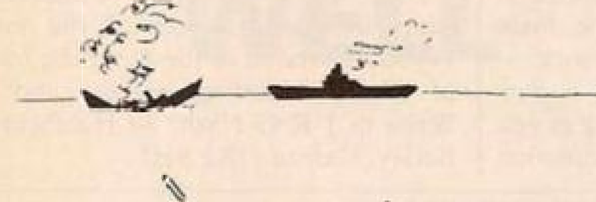
(continued on page 91)

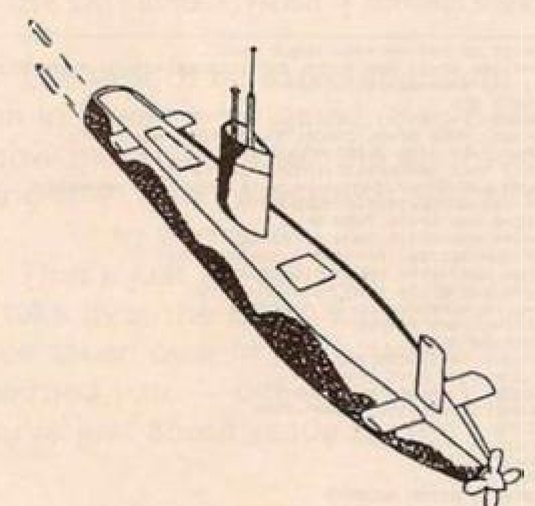
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SOFTWARE





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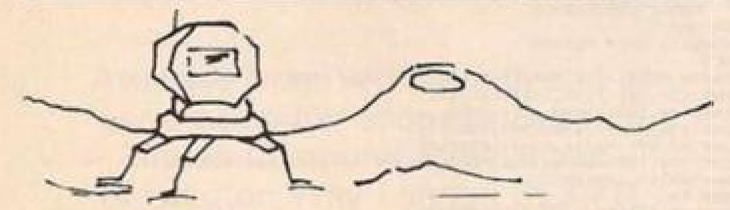
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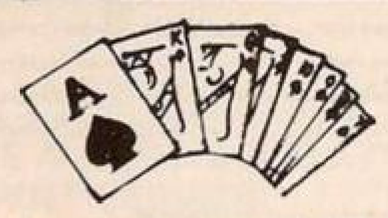
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(continued from page 89)

```
7020 HA=96:X1=112:X2=144:X3=96:X4=160:Y2=144:UC=0:FF=0:SS=70
7030 GOSUB3000
7100 JO=JOYSTK(0):JO=JOYSTK(1):RU=JOYSTK(2):JP=JOYSTK(3)
7110 IFJO>42THEN HA=HA+4:IFJO>52THEN HA=HA+8
7120 IFJO<22 THEN HA=HA-4:IFJO<12 THEN HA=HA-8
7130 IFHA>192 THEN HA=192
7140 IFHA<0 THEN HA=0
7150 HT=HT-(96-HA)/8:IFHT<0 THEN HT=0
7160 RP=2500-(30*JP)
7165 FU=FU-35*RP/(1800*1800)
7166 IF FU<=0 THEN RP=600
7170 VS=HA-96
7180 SP=SP-(HA-96)/10+(RP-1700)/100+2*(UC=1)+2*(FF=1)
7190 AY=AY-SP/720*COS(HD/57)
7200 PE=PEEK(65280):IFPE=125 OR PE=253 THEN HT=HT*10:GOSUB3000:HT=HT/10
7202 IF PE=126 OR PE=254 THEN GOSUB 6000
7205 Q$=INKEY$
7210 IF Q$="G"  AND SP<120 THEN UC=1
7215 IF Q$="F" AND SP<140 THEN FF=1:SS=60
7216 IF Q$="O" THEN 500
7217 Q$=""
7220 IFSP<80 THEN GOSUB 4000: IF SP<SS THEN GOTO 5000
7225 IFSP>(VN-7) THEN GOSUB6500
7230 IF SP>VN THEN GOTO5500
7240 IF UC=1 THEN FOR U=163 TO 170:PSET(U,192,8):NEXTU
7245 IF FF=1 THEN FOR U=50 TO 56:PSET(U,192,8):NEXTU
7250 X1=128-32*(500/(HT+1)):IFX1<96 THEN X1=96
7260 X2=128+32*(500/(HT+1)):IFX2>160 THEN X2=160
7270 X3=128-48*(500/(HT+1)):IF HT<500 THEN X3=80*HT/500
7280 X4=128+48*(500/(HT+1)):IFHT<500 THEN X4=256-(80*HT/500)
7282 HD=HD+(RU-32)/4:IFHD<0 THEN HD=HD+360
7283 IFHD>=360 THEN HD=HD-360
7285 AX=AX+SP/720*SIN(HD/57)
7290 OS=40*(128-AX)
7300 X1=X1+OS:X2=X2+OS:X3=X3+OS:X4=X4+OS
7310 Y2=HA+32000/(HT+1):IFY2>192 THEN Y2=192
7320 IFX1<0 THEN X1=0:IFX2<=0 THEN PCLS:PCOPY 8 TO 4:LINE(0,HA)-(256,HA),PSET:GO
TO 7100
7330 IFX2>256 THEN X2=256:IFX1>=256 THEN PCLS:PCOPY 8 TO 4:LINE(0,HA)-(256,HA),P
SET:GOTO 7100
7490 FORM=1 TO 4:PCOPY(M+4) TO M:NEXTM
7491 IFX3<0 THEN X3=0
7492 IFX4>256 THEN X4=256
7500 LINE(0,HA)-(256,HA),PSET
7510 LINE(X1,HA)-(X3,Y2),PSET
7520 LINE(X2,HA)-(X4,Y2),PSET
7600 SCREEN1,1
7610 REM TEST IF ON GROUND
7620 IFHT<5 AND SP<90 AND VS>-32 THEN 7630
7625 IFHT<=5 ANDVS<-15 THEN HT=HT-VS
7626 GOTO7100
7630 IFUC=0 THEN SCREEN0,0:CLS:PRINT "IDIOT! YOU LANDED WITH THE WHEELS UP!":STO
P
7640 PCLS:GF=1
7650 REM ON GROUND
7660 LINE(0,96)-(256,96),PSET
7670 LINE(96,96)-(0,192),PSET
7680 LINE(160,96)-(256,192),PSET
7690 IFGF=1 THEN LINE(128,96)-(128,144),PSET
7700 IFGF=-1 THEN LINE(128,96)-(128,144),PRESET
7710 GF=-GF
7720 DE=500/(SP+1):FORD=1 TO DE:NEXTD
7730 SCREEN1,1
7740 PE=PEEK(65280):IFPE=125 OR PE=253 THEN HT=HT*10:GOSUB 3000:HT=HT/10
7742 IF PE=126 OR PE=254 THEN GOSUB 6000
7745 PCOPY8 TO 4
7750 FORJ=0 TO 3:JO=JOYSTK(J):NEXTJ:RP=2500-(30*JO):FU=FU-35*RP/(1800*1800):IF F
U<=0 THEN RP=600
7751 SP=SP+(RP-1700)/200
7760 IFSP<=0 THEN SCREEN0,0:CLS:PRINT"SAFE LANDING":GOTO12000
7765 IFAX<127 OR AX>129 THEN SCREEN0,0:CLS:PRINT"YOU RAN OVER THE EDGE OF ","THE
 RUNWAY":GOTO12000
7770 AY=AY-SP/720:IFAY<86 THEN SCREEN0,0:CLS:PRINT"YOU RAN OVER THE END OF THE R
UNWAY":GOTO12000
7780 GOTO7650
8500 REM FIRE ROUTINE
8505 IFAM<1 THEN 8999
8510 SOUND1,1:AM=AM-1
8520 IFPPOINT(128,96)<>6 AND PPOINT(128,95)<>6 AND PPOINT(128,97)<>6 THEN 8999
8522 EXEC32368:REM M/C EXPLOSION
8523 FORD=1 TO 400:NEXT
8524 LM=LM-1:IFLM>0 THEN 8999
8525 SCREEN0,0:CLS
8530 ES=ES+1
8540 PRINT"SCORE ";ES,"AMMO ";AM:FORD=1 TO 2000:NEXTD
8550 AF=0:SCREEN1,1:PCLS
8999 PE=0:RETURN
9000 REM INSTRUCTIONS
9005 CLS
9010 PRINT"please";CHR$(128);"read";CHR$(128);"the";CHR$(128);"instructions":PRI
NT"while";CHR$(128);CHR$(105);CHR$(128);CHR$(97);CHR$(109);CHR$(128);"initialisi
ng"
9020 PRINT:PRINT"LH JOYSTICK CONTROLS","THROTTLE AND RUDDER","WHILE THE BUTTON U
PDATES"," THE DIALS"
9030 PRINT:PRINT"RH JOYSTICK CONTROLS PITCH","AND ROLL WHILE THE BUTTON","GIVES
A MAP AND FUEL GAUGE"
9040 PRINT:PRINT"YOUR STALLING SPEED IS 70","AND VNE IS 240"
9100 RETURN
9200 REM YOU ARE HIT
9205 FOR D=1 TO 4:EXEC32400:NEXT D:REM WOBBLE
9210 LV=LV-1:IF LV<1 THEN 9400:'LIVES
9215 CY=-1:SOUND240,3
9220 RQ=RND(3):ON RQ GOTO 9230,9280,9330
9230 SCREEN0,0:CLS:PRINT"FUEL TANK HOLED":FU=FU-10
9240 FORD=1 TO 2000:NEXT:SCREEN1,1:GOTO6999
9280 SCREEN0,0:CLS:PRINT"OIL FEED HIT",,"ENGINE REVS REDUCED BY 500":MR=MR-500
9290 FORD=1 TO 2000:NEXT:SCREEN1,1:GOTO6999
9330 SCREEN0,0:CLS:PRINT"AIRFRAME DAMAGED","VNE REDUCED BY 40KT.":VN=VN-40:SP=SP
-40
9340 FORD=1 TO 2000:NEXT:SCREEN1,1:GOTO6999
9400 SCREEN0,0:CLS:PRINT"BALE OUT!"
9410 FOR D=1 TO 2000:NEXT
9420 REM CRASH ROUTINE HERE
9422 SCREEN1,1
9425 FOR HA=96 TO 0 STEP -12:FORZ=1 TO 4:PCOPY(Z+4) TO Z:NEXTZ
9426 LINE(0,HA)-(256,HA),PSET
9427 POKE32766,6+(HA+3)*32/256:POKE32767,127:POKE32762,24:POKE32763,31:EXEC32303
9428 NEXTHA
9429 FORZ=1 TO 4:PCOPY(Z+4) TO Z:NEXT:POKE32766,6:POKE32767,127:POKE32762,24:POK
E32763,31:EXEC32303
9430 FORZ=1 TO 255 STEP 2:SOUNDZ,1:NEXT
9434 PCLS:FOR Q=1 TO 12
9435 FORZ=0 TO 3:DRAW"A"+STR$(Z):PCLS
9440 DRAW"BM0,0;F250;BL250;E250"
9445 PCLS8
9450 NEXTZ,Q
9455 DRAW"A"+STR$(0)
9460 PCLS
9600 DATA70,65,190,65,70,65,125,185,190,65,135,185,105,65,130,185,130,65,130,185
,155,65,130,185,110,177,150,177,110,180,125,180,135,180,150,180,125,177,125,192,
135,177,135,192,125,185,135,185,125,188,135,188
9610 FORZ=1 TO 13:READX,Y,A,B:LINE(X,Y)-(A,B),PSET:NEXT
9615 RESTORE
9620 CIRCLE(130,130),90,8,1,.64,.88
9630 CIRCLE(130,165),5
9640 CIRCLE(107,177),5
9650 CIRCLE(153,177),5
9700 FORD=1 TO 5000:NEXT
9710 CLS:GOTO12000
9999 GOTO9999
10000 REM STRINGS
10010 A$(1)="BD1E1R1F1D2NF1G1L1H1E1R1F1BR3BU3":'A
10011 A$(2)="BR1NR2G1F1R1F1G1L2BR5BU4":'S
10012 A$(3)="ND4BU1U1BR15BD2":'I
10013 A$(4)="D4U3E1R1F1BR2BU1":'R
10014 A$(5)="D4ND2R2E1U2H1L2BR5":'P
10016 A$(6)="D4U3E1F1ND3E1F1D3BR15BU4":'M
10017 A$(7)=A$(1):'A
10018 A$(8)="NU2D3F1E1BR2BU3":'L
10019 A$(9)="R1NU2NR2D3F1E1BR7BU3":'T
10020 A$(10)="BD1E1R1F1NG3D2G1L1H1U2BR4BU1":'O
10021 A$(11)="BD1E1D4L1R2BR1BU4":'1
10022 A$(12)="BD1E1R1F1D1G2L1R3BR1BU4":'2
10023 A$(13)="BD1E1R2F1G1NL2F1G1L2H1BU3BR4":'3
10024 A$(14)="BD2E2D2NR1ND2L2BU2BR4":'4
10025 A$(15)="NR3D2R2F1G1L2BR4BU4":'5
10026 A$(16)="BD1E1R2BL2BG1D2F1R1E1H1L2BR4BU2":'6
10027 A$(17)="R3D1G3BR4BU4":'7
10028 A$(18)="BR1R2F1G1L2H1NE1F1G1F1R2E1H1BR2BU2":'8
10029 A$(19)="BR1R1F1D2G1L2BU3NE1F1R1E1BR1BU1":'9
10030 A$(20)="NU2D4U3E1R1F1D3BR1BU4":'H
10031 A$(21)="BR3NU2D4L2H1U2E1R2BR1":'D
10032 A$(22)="BR1R2F1D1G1L2H1U1NE1D1F1R3D2G1L2":'G
10034 B$="":C$=""
10035 FORC=1 TO 9:B$=B$+A$(C):NEXTC
10036 FORC=20 TO 22:C$=C$+A$(C):NEXTC
10037 A$(23)="R1U2E1R1F1BD2BL1L2D4BU4BR3":A$(24)="D3F1R1E1NF1U3BR2":A$(25)="BR1R
2F1D1L4U1NE1D2F1R2E1BU3BR2":REM F,U,E
10038 F$=A$(23)+A$(24)+A$(25)+A$(8)
10040 DRAW"BM12,156;S8"
10050 DRAWB$
10060 DRAW"BM186,156"
10070 DRAWC$
10080 DRAW "BM52,184;S4"
10085 DRAW A$(23)
10090 DRAW"BM164,182;S4"
10095 DRAW A$(22)
11100 RETURN
12000 PRINT:PRINT"(A) TO FLY AGAIN"
12010 IF INKEY$="A" THEN SP=100:HA=96:HT=3000:AY=96:AX=128:FU=40:VN=240:MR=2500:
LV=RND(3):AF=0:CLS:GOTO420
12020 GOTO12010
```

Alterations for keyboard operation.

```
10 HA=96:YF=0:YO=0:XO=0:ES=0:AM=50:VN=240:MR=2500:LV=RND(3):RU=30
435 CLS:PRINT"IN THIS VERSION, X WILL SHOOT","AT THE ENEMY AIRCRAFT"
445 IFQ$="L" THEN HT=999:HD=0:SP=100:AX=128:AY=115:RP=2000:SP=120:GOTO7420
506 Q$=INKEY$
510 IFQ$=CHR$(9) THEN N=N-1
520 IF Q$=CHR$(8) THEN N=N+1
820 IFQ$=CHR$(94) THEN HA=HA-V
825 IFQ$=CHR$(10) THEN HA=HA+V
915 IFQ$="F" THEN RU=12
916 IF Q$="S" THEN RU=52
917 IF Q$="I" THEN RP=RP + 100
918 IF Q$="D" THEN RP=RP-100
919 IFRP<600 THEN RP=600
920 IFRP>MR THEN RP=MR
975 IF Q$="X" THEN GOSUB8500
980 IFQ$="Q" THEN GOSUB3000
991 Q$="":RU=32
3105 RP=2200
3305 Q$=INKEY$
3310 IF INKEY$="S" THEN EF=1:GOTO3315
3314 IFQ$="D" THEN RP=RP-100:IF RP<600 THEN RP=600
3315 IFQ$="I" THEN RP=RP+100:IF RP>2500 THEN RP=2500
3330 IFQ$="Q" THEN HT=HT*10:GOSUB3000:HT=HT/10
3335 IFQ$="M" THEN GOSUB6000
3403 IF Q$="G" THEN UC=0
3420 IFQ$=CHR$(10) THEN HA=HA+8
3425 IFQ$=CHR$(94) THEN HA=HA-8
3890 Q$=""
5020 IF INKEY$=CHR$(94) AND HT>2000 THEN N=24:HA=8:SP=100:YF=0:YO=0:XO=0:GOTO
7100 Q$=INKEY$:RU=32
7101 IFQ$="F" THEN RU=20
7102 IFQ$="S" THEN RU=44
7110 IFQ$=CHR$(10) THEN HA=HA+4
7120 IFQ$=CHR$(94) THEN HA=HA-4
7160 IFQ$="D" THEN RP=RP-100:IF RP<600 THEN RP=600
7161 IFQ$="I" THEN RP=RP+100:IF RP>2500 THEN RP=2500
7200 IFQ$="Q" THEN HT=HT*10:GOSUB3000:HT=HT/10
7202 IFQ$="M" THEN GOSUB6000
7217 Q$=""
7655 Q$=INKEY$
7740 IFQ$="Q" THEN HT=HT*10:GOSUB3000:HT=HT/10
7742 IFQ$="M" THEN GOSUB6000
7748 IFQ$="I" THEN RP=RP+100:IF RP>MR THEN RP=MR
7749 IFQ$="D" THEN RP=RP-100:IFRP<600 THEN RP=600
7750 IF FU<1 THEN RP=600
7775 Q$=""
9020 PRINT:PRINT"I & D CONTROL ENGINE","F & S GIVE RUDDER CONTROL","AND U UPDATE
S INSTRUMENTS"
9030 PRINT:PRINT"ARROW KEYS CONTROL ROLL","AND PITCH, WHILE M GIVES MAP","AND FU
EL GAUGE"
12010 IF INKEY$="A" THEN SP=100:HA=96:HT=3000:AY=96:AX=128:FU=40:VN=240:M[illegible]25
LV=RND(3):AF=0:RU=32:CLS:GOTO420
```

DELETE THESE LINES: 826, 847, 976, 3312, 7205.

```
7160 IF Q$="I" THEN RP=RP+100:IF RP>MR THEN RP=MR
```

will deny you maximum revs when landing after oil feed damage.

Decimal listing of machine-code routines.

```
32256 204   0   0   253  127  252  204  0    96   243
32266 127   254 16  179  127  250  36   28   253  127
32276 254   190 127 254  198  1    166  132  129  0
32286 38    224 231 128  124  127  252  246  127  252
32296 193   32  39  212  32   234  57   204  0    0
32306 253   127 252 204  0    96   243  127  254  16
32316 179   127 250 36   30   253  127  254  190  127
32326 254   198 1   166  132  129  0    38   224  231
32336 132   166 130 124  127  252  246  127  252  193
32346 32    39  210 32   232  57   0    0    0    0
32356 0     0   0   0    0    0    0    0    0    0
32366 0     0   16  142  16   207  142  127  96   166
32376 128   167 160 166  128  167  160  166  128  167
32386 164   49  168 30   16   140  19   46   36   2
32396 32    233 57  0    142  24   0    16   142  25
32406 0     166 160 167  128  16   140  30   0    36
32416 2     32  244 142  29   0    16   142  30   0
32426 166   130 167 162  140  24   0    35   2    32
32436 245   57  57  0    0    0    0    0    0    0
```

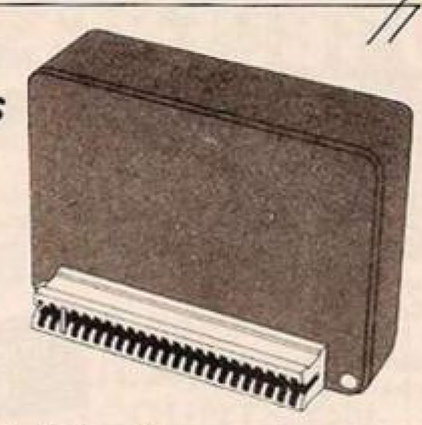
Machine-code explosion data.

```
32608 192   192 192 192  192  192  0    192  0    0
32618 192   0   0   192  0    12   204  0    12   204
32628 0     3   240 0    3    240  0    255  255  192
32638 3     240 0   3    240  0    12   204  0    12
32648 204   0   0   192  0    0    192  0    0    192
32658 0     192 192 192  192  192  192  0    0    0
```

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Dec/Jan Issue. Program Features: Space City (Invader type game), Breakout, Artist (joystick painting program), Rescue (miraculously retrieves program after Bad Loading or "Bad Program Message") and Pack — a program to compact basic programs and disc system review. Software reviews — including Wordwise. Book reviews, adding Joysticks, interface to Model A. How to assess the video controller chips and ideas for the newcomer, plus a new crop of hints and tips.

February Issue: Program Features: BEEBMAZE — Find you way through the random maze, guided by 3D views from inside the maze — an excellent game. FIVE-DICE — A Beeb implementation of YAHTZEE (R), a novel dice game. Also a listing of WINDY FIELD — a creation from Acornsoft, SPIROPLOT screen doodler, and a complete memory display program in a user key. Plus Machine Code Screen Dumps for the Epson and Seikosha Printers; articles on USING FILES, IDEAS ON ANIMATION (including a Rotating Cube program) an Introduction to the use of Procedures, a Survey of Books on the BBC Micro, and a Roundup of Disc System Hints. PLUS a variety of HINTS, TIPS AND INFO, including a single VDU command to perform a SIDEWAYS SCROLL.

March: Program Features: Life (32k), Artillery Duel (16k/32k), Square Dance, 3D Rotation (will rotate any object). Microsketch (16k) screen drawing program in only one line of code. Printers for the BBC micro — Review of Epson, Seikosha, Tandy and Olivetti, What to do with the new Operating System Chip, Disc Formatter Program, and full Disc instruction set, Newcomers article on Text and Graphics Windows.

PLUS How to get a new Operating System ROM and a special deal on Wordwise (members only).

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STOP PRESS

BEEBUG has negociated a deal with ACORN over the new 1.2 OPERATING SYSTEM ROM. BEEBUG members are offered the ROM at around half-price. See BEEBUG Feb issue for details.

YC6

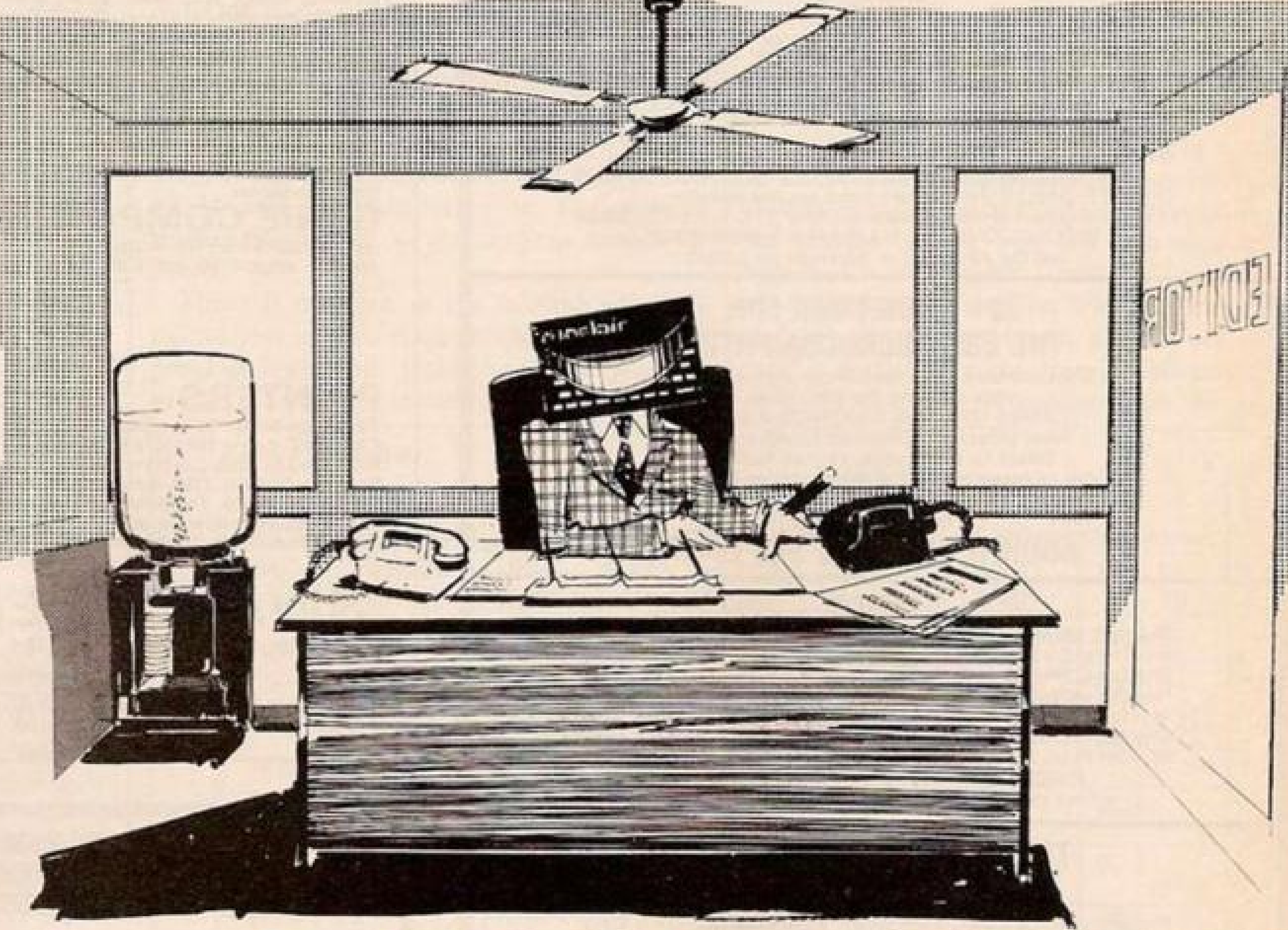
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EDITOR

```
100 PRINT "List From"
110 GO SUB 8100
120 LET a=x
130 GO SUB 8000
140 PRINT x$;" ";
150 FOR j=1 TO 4
160 LET x=PEEK a
170 GO SUB 8050
180 PRINT x$;" ";
190 LET a=a+1
200 NEXT j
210 PRINT
220 GO TO 130
300 PRINT "Write To"
310 GO SUB 8100
320 LET a=x
340 LET x=a
350 GO SUB 8000
360 PRINT x$;" ";
370 INPUT a$
380 IF a$="S" THEN STOP
390 IF LEN a$<>2*INT
    (LEN a$/2) THEN
    GO TO 370
400 PRINT a$
410 LET x$=a$( TO 2)
420 GO SUB 8120
430 POKE a,x
440 LET a=a+1
450 LET a$=a$(3 TO )
460 IF a$>"" THEN GO
    TO 410
470 GO TO 340
500 PRINT "Run From"
510 GO SUB 8100
520 CLS
530 LET A=USR x
540 STOP
8000 LET x=INT (a/256)
8010 LET z=x
8020 GO SUB 8050
8030 LET x=a-z*256
8040 GO TO 8060
8050 LET x$=""
8060 LET k=INT (x/16): LET
    y=k: IF y>9 THEN LET
    y=y+7
8070 LET x$=x$+CHR$ (y+48)
8075 LET k=x-k*16: IF k>9
    THEN LET k=k+7:
8080 LET x$=x$+CHR$ (k+48)
8090 RETURN
8100 INPUT x$
8110 IF LEN x$<>4 THEN GO
    TO 8100
8120 LET x=0
8130 FOR i=1 TO LEN x$
8135 LET y=CODE x$(i): IF
    y>57 THEN LET y=y-7
8140 LET x=x*16+y-48
8150 NEXT i
8160 RETURN
```

Figure 1. Hexadecimal loader



Trevor Hill dons his green eyeshade and presents a program which stops you making wrong inputs to your Spectrum

THIS EDITOR program provides a user-friendly set of routines that will protect against invalid input as far as possible. The routines have been located at the top end of RAM, just below the space reserved for user-defined graphics. Consequently other programs on which you wish to use the routines may be loaded in the normal manner. The listing is for a 16K Spectrum but details to relocate the code for a 48K model are included later in the article. The Basic program is as program 1.

To enter the menu Run 9999. The first 11 routines occupy just under 3K of memory and you will see that provision has been made for a further five routines. A particular routine is called by input of the appropriate routine number. Should you accidentally call up one of the last five routines the program will default to routine 00.

Whenever input is required a prompt message is displayed followed by a flashing question mark. Any time that input is being requested the routine may be terminated by use of Break — Shift Space. Should you make a typing error it may be corrected by use of Delete — Shift 0. Once input is complete the flashing question mark remains until you confirm input by Enter.

In order to illustrate the use of routine 00, which is a disassembler, you are asked for the start and finish addresses and print details. The routine knows that addresses must be in hexadecimal and will only accept input of the correct length. Should you type in a finish address lower than the start address the routine will be aborted. Input 11 in order to dump to the printer — any other input will dump to the screen. As in Basic screen full will give the Scroll message. N will terminate the routine, almost any other key will cause the display to continue.

The disassembler handles correctly all Z-80 instructions and recognises that RST 08 and RST 28 instructions are followed by data bytes. Since labels are not included, JR instructions give as part of the mnemonic the absolute jump address.

Routine 01, the Print Data routine, is similar to routine 00 except that Output is now Data. In figure 5, routine 02 will interpret the bytes as character codes. Codes 00 to 1F do not represent characters and a flashing question mark will be printed whenever the routine comes across one of these codes.

Routine 03 — Write Code — allows the input of instructions or data. It is intended that each line of input should correspond to one instruction so the maximum number of bytes that will be accepted is four. The program knows that each byte occupies two hex digits, so it will not accept an odd number of digits. Exit from this routine is by Break.

Routine 04 — Write Chr$ — is similar to routine 03 except the input now represents characters. Numbers, upper and lower case letters and the symbols in red on the keys — function shift — may be input. I have excluded the keywords written on the keys and symbols <=, <>, >= since the use of the delete key

(continued on page 97)

(continued from page 95)

would mess up the display; these, and the other keywords, will have to be input using their character codes and routines 03.

Routine 05 — Insert — enables the insertion of code. The present limit is the highest address to which code has been written. You will see that an opportunity is given to change the limit value. As code is input, room is made for it by moving up the existing code between the write address and limit address. Figure 15 shows the effect of the input given in figure 8; exit from the routine is by Break.

Routine 06 — Delete — deletes code from Start address to Finish address. The purpose of the Limit address is as described for routine 5. This time, code is removed by moving the code after Finish address down memory to Limit address. The byte immediately after Finish address will end up in Start address and so on. In both routines 05 and 06 if the relationship between Start, Finish and Limit addresses does not make sense then the routine will be aborted.

Routine 07 — Move routine — transfers a block of code to some other location. The transfer may be up or down memory, the routine will sort out the details. The code in Start address is moved to Move address, the code is Start address + 1 to Move address + 1 and so on. If the move is down memory the limit address remains unchanged but can be changed by using routine 05 (exit from routine 05 after changing limit). If the move is up memory then the limit address is updated automatically.

Routine 08 called Search enables a block of memory to be searched for a particular sequence of code. The search code may be from one to eight bytes in length. This routine is particularly useful if you are thinking of modifying a sub-routine and you wish to know exactly where in the program it is being called. The addresses listed are where the start of the code occurs. Screen full will give the opportunity to Scroll. Routine 09 — Replace — enables a block of memory to be searched for a particular sequence of code and wherever it is found, replaced. The code may be from one to eight bytes in length and once the search length is decided the routine will only accept a replacement code of the same length. This routine will be particularly useful later for modifying the program for the 48K Spectrum.

Routine OA — the Run routine — is used to run other machine-code programs. If break points are not required then input an address in ROM as the break point — say 0000. This, of course, will have no effect. The left hand registers are the main set and the right hand registers the alternative set. You now have the option of either: continuing to run from the break point with no further breaks — type in a ROM address; continuing to run with a further break point; or aborting the routine by Break.

There is no limit to the number of break points you use, so single stepping through a program is possible. Just keep on changing the break point by one instruction at a time. One word of warning — when a break point is inserted in a program it actually changes the program by inserting a JP instruction. As long as you hit the break point the program will be automatically returned to its original value. If for some reason the break point is not reached you will have to correct the program manually.

Some possibilities for additional routines that spring to mind are an assembler, user-defined graphics generator, hex/octal/binary/decimal conversion routines, two-pass disassembler — but I must move on to something else.

Table 1 includes the locations where you should store the addresses of your routines. To modify the menu to display your routine titles only requires the addition of data starting at 7E86. The menu details start at 7E00 and consist of the character code corresponding to the routine names. The end of a message is signified by having bit 7 set.

I have included the first few bytes in table 2 and if you carry on you should see what modifications to make from 7E86 onwards.

(continued on next page)

Table 1. Variables.

				Routine addresses			
Address	Contents	Address	Contents	Address	Contents	Address	Contents
7F00	Variable	7F28	Break	7F38	00 6C	7F48	08 EE
	string	7F29	Point	7F39	77	7F49	76
		7F2A	code	7F3A	01 8E	7F4A	09 AE
		7F2B	C3	7F3B	79	7F4B	76
		7F2C	CF	7F3C	02 7C	7F4C	0A 95
		7F2D	73	7F3D	75	7F4D	73
		7F2E	Limit	7F3E	03 52	7F4E	0B
7F1F		7F2F	address	7F3F	77	7F4F	
7F20		7F30	Transfer	7F40	04 B7	7F50	0C
7F21		7F31	address	7F41	75	7F51	
7F22		7F32	Finish	7F42	05 34	7F52	0D
7F23		7F33	address	7F43	76	7F53	
7F24		7F34	Start	7F44	06 09	7F54	0E
7F25		7F35	address	7F45	76	7F55	
7F26		7F36	String	7F46	07 37	7F56	0F
7F27		7F37	address	7F47	75	7F57	

Table 3. 48K Changes made using replace routine.

16K	48K	16K	48K	16K	48K	16K	48K
CD887A	CD88FA	C3A173	C3A1F3	CD857A	CD85FA	267D	26FD
CD987A	CD98FA	CDE474	CDE4F4	21FC7C	21FCFC	2678	26F8
CDA57A	CDA5FA	CDEE74	CDEEF4	216677	2166F7	21007E	2100FE
CDAD7A	CDADFA	CDF974	CDF9F4	DA4176	DA41F6	218C79	218CF9
CDBB7A	CDBBFA	CD0475	CD04F5	2A2E7F	2A2EFF	267F	26FF
CDC57A	CDC5FA	CD2375	CD23F5	ED532E7F	EC532EFF	21107E	2110FE
CDC97A	CDC9FA	CDE075	CDE0F5	DAFD76	DAFDF6	21DF79	21DFF9
CDCA7A	CDCAFA	CD6B76	CD6BF6	21367F	2136FF	21007F	2100FF
CDE07A	CDE0FA	CD1F77	CD1FF7	ED5B347F	ED5B34FF	11357F	1135FF
CDF07A	CDF0FA	CD3377	CD33F7	222E7F	222EFF	ED5B367F	ED5B36FF
CDFA7A	CDFAFA	CD4277	CD42F7	21B77E	21B7FE	ED53367F	ED5336FF
CD257B	CD25FB	CD8278	CD82F8	112F7F	112FFF	210F7B	210FFB
CD3B7B	CD3BFB	CD9B7A	CD9BFA	212F75	212FF5	267E	26FE
CDB57B	CDB5FB	CD9378	CD93F8	213175	2131F5	C3FD76	C3FDF6
CDB77B	CDB7FB	CDB478	CDB4F8	11187F	1118FF	ED5B2E7F	ED5B2EFF
CDC07B	CDC0FB	CDF578	CDF5F8	21187F	2118FF	212F7A	212FFA
213375	2133F5	CDD478	CDD4F8	ED53347F	ED5334FF	CDDC78	CDDCF8
11287F	1128FF	CDBF79	CDBFF9	11107F	1110FF	267C	26FC
22307F	2230FF	CDC279	CDC2F9	212D7A	212DFA	212479	2124F9
2A347F	2A34FF	CDE179	CDE1F9	21097D	2109FD	213575	2135F5
2A207F	2A20FF	CDE479	CDE4F9	32367F	3236FF	CD747A	CD74FA
ED73307F	ED7330FF	CDE879	CDE8F9	21F67C	21F6FC	22347F	2234FF
21287F	2128FF	CDEC79	CDECF9	320B7D	320BFD	CD6B7A	CD6BFA
ED5B327F	ED5B32FF	CDFF79	CDFFF9	210A7D	210AFD	22367F	2236FF
21B17E	21B1FE	CD027A	CD02FA	21167D	2116FD	2A327F	2A32FF
11337F	1133FF	CD157A	CD15FA	21FE7C	21FEFC	CD5B7A	CD5BFA
21DF7B	21DFFB	CD1C7A	CD1CFA	C3C97A	C3C9FA	2A367F	2A36FF
ED5B307F	ED5B30FF	CD317A	CD31FA	21FD7D	21FDFD		
212A75	212AF5	CD367A	CD36FA	21FE78	21FEF8		

Table 2. Print Data

Address	Byte	CHR$	Address	Byte	CHR$
7E00	20		7F00	30	O
7E01	20		7F01	30	O
7E02	20		7F02	20	
7E03	20		7F03	50	P
7E04	4D	M	7F04	52	R
7E05	45	E	7F05	49	I
7E06	4E	N	7F06	4E	N
7E07	D5	U	7F07	54	T
7E08	20		7F08	20	
7E09	20		7F09	43	C
7E0A	20		7F0A	4F	O
7E0B	20		7F0B	44	D
7E0C	3D	=	7F0C	C5	E
7E0D	3D	=	7F0D	30	0
7E0E	3D	=	7F0E	31	1
7E0F	BD	=	7F0F	20	

Table 4. 48K Changes Using Write Code Routine

Address	Byte	Address	Byte
FF2D	F3	FF47	F5
FF37	FF	FF49	F6
FF39	F7	FF4B	F6
FF3B	F9	FF4D	F3
FF3D	F5	FF4F	F7
FF3F	F7	FF51	F7
FF41	F5	FF53	F7
FF43	F6	FF55	F7
FF45	F6	FF57	F7

(continued from previous page)

You will also of course have to amend the Basic program to make more memory available above RAMtop. If you decide to have a go at understanding how the program works I would suggest you leave the disassembler till last since it does call a couple of complicated routines. In fact the Add String routines can call themselves up to twice and it is possible to lose track of what is going on myself. The machine stacks start to look a bit like Clapham Junction.

I keep details of the routines on flow charts and if any one would like a set I am quite prepared to provide them. But please enclose £1 to cover the cost of photocopying, postage and overdraft.

Now fo the modifications to convert for the 48K mocel. Use routine 07 — Move — to locate a copy of the 16K program at the top of RAM. The Start address is F395, Finish address FF57.

Use routine 09 — Replace — to change the Call, JP, JR and absolute addressing instructions. In each case start address' is F395, finish address FBDE, search code as in the 16K column of table 3, replaee code as in the 48K column. Next, use routine 03 — Write code — to change the bytes indicated in table 4. Now, modify the Basic listing. Save a copy of the program using Run 9997.

To test the 48K version switch the Spectrum off and then on, and Load. If all is well Run 9999 should take you into the menu.

The 48K version does have one idiosyncracy — that is a posh way of avoiding the word bug. Some of the routines detect that they have finished by comparing the next address with the Finish address. The routines actually subtract the next address from the Finish address and Return if a Carry is generated. In the 16K version this is acceptable since the largest address you will need is 7FFF and when the Start address reaches 8000 the Carry is produced.

In the 48K version, however, the largest address now possible is FFFF and so we should stop when the start address moves from FFFF to 010000. But of course the Z-80 only uses two bytes for addresses, therefore the Start address actually changes to 0000 and a Carry will not be generated. So be warned — if your Finish address is FFFF then some of the routines will never terminate.

If this feature of the program upsets you then the routine you will need to modify is at 79E1 to 79EB.

If anyone intends to modify the ZX-81 version of this program to work in a 64K model then the same problem exists. The routine on the ZX-81 that will require modification is at 7B81 to 7B8B.

Figure 1 lists a hex loader. Run 100 to list code, Run 300 to write code and run 500 to execute code. Run 9997 to save. The loader is intended to work with Caps Lock On. Terminate Write by inputting S.

Program 1.

```
9996 STOP
9997 SAVE "editor" LINE 9998: SAVE
"editor"CODE 29589,3011: STOP
9998 CLEAR 29588: LOAD "editor"CODE:
STOP
9999 RANDOMISE USR 31019
```

To enter the machine code type in the hex loader in figure 1 and then Run 300. When the program gives the prompt "write to" type the start address in hex, 73F5, and press Return. You can now enter the code either in blocks or an instruction at a time. After entering the instruction at address 7E00 type S to stop, rerun the program and the two further sections of code at 7F2B and 7F36.

Finally, if you are interested in the program but do not want to type in such lengthy code, then I can supply a tape for £3 plus 50p postage' and packing from the following address — 1 Highcroft Close, Yardley Gobion, Northamptonshire. ■

Figure 2. Main program

```
73F5 7F 01 03 00 ED B0 CD 6B
73FD 0D FE CB 02 86 21 B1 7E
7405 CD C5 7A 2E E3 CD C9 7A
740D FD 36 76 00 CD E0 75 3E
7415 20 D7 11 33 7F CD 8B 7A
741D 3E 06 07 3E 0D D7 21 DF
7425 7B CD C5 7A FD 36 76 00
742D CD E0 75 FD 36 76 03 CD
7435 E0 75 CD C5 7A FD 36 76
743D 00 CD E0 75 C1 CD 04 75
7445 FD 36 76 01 CD E0 75 C1
744D CD 04 75 3E 0D D7 3E 0D
7455 D7 D1 CD EE 74 D1 CD E4
745D 74 3E 0D D7 06 03 D1 CD
7465 EE 74 7B CD F9 74 D1 CD
746D E4 74 7B CD F9 74 3E 0D
7475 D7 10 EB 3E 0D D7 0E 02
747D 06 07 3E 20 D7 10 FB D1
7485 CD EE 74 7B CD F9 74 3E
748D 0D D7 0D 20 EB 00 00 00
7495 00 06 07 3E 20 D7 10 FB
749D ED 5B 30 7F CD EE 74 7B
74A5 CD F9 74 3E 0D D7 3E 0D
74AD D7 06 05 3E 20 D7 10 FB
74B5 2A 30 7F 5E 23 56 21 2A
74BD 75 CD EE 74 7B CD F9 74
74C5 3E 0D D7 3E 0D D7 2A 32
74CD 7F 22 34 7F 21 35 75 01
74D5 04 01 FD CB 30 DE 11 33
74DD 7F CD 36 7A C3 A1 73 FD
74E5 36 76 01 CD E0 75 7A 18
74ED 0B CD C5 7A FD 36 76 00
74F5 CD E0 75 7A C5 E5 21 FC
74FD 7C CD A5 7A E1 C1 C9 CB
7505 79 CD 23 75 CB 71 CD 23
750D 75 CB 61 CD 23 75 CB 51
7515 CD 23 75 CB 49 CD 23 75
751D CB 41 CD 23 75 C9 3E 30
7525 28 01 3C D7 C9 20 53 50
752D 29 BA CE C3 BF F2 BD E3
7535 B1 E3 06 03 21 66 77 CD
753D 31 7A CD E1 79 DA 41 76
7545 23 E5 2A 30 7F E5 CD E8
754D 79 E1 30 06 EB C1 ED B0
7555 18 22 ED 5B 32 7F C1 C5
755D 0B AF 23 0B B9 20 FB B0
7565 20 F8 C1 E5 EB ED B8 D1
756D 2A 2E 7F CD E8 79 30 04
7575 ED 53 2E 7F C3 FD 76 06
757D 02 21 66 77 CD 31 7A 00
7585 00 00 CD E1 79 38 18 CD
758D 85 7A 2A 34 7F 7E 23 22
7595 34 7F FE 20 30 08 3E 3F
759D D7 CD C0 7B 18 01 D7 CD
75A5 E1 79 DA FD 76 CD 03 08
75AD 3E 0A B9 38 DD 3E 0D D7
75B5 18 D5 06 01 21 A6 77 CD
75BD 31 7A FD CB 30 9E FD 36
75C5 76 01 01 10 09 CD 02 7A
75CD 21 36 7F 4E 0D AF 47 6F
75D5 ED 5B 34 7F ED B0 CD 1C
75DD 7A 18 E7 C5 D5 E5 CD 03
75E5 08 FD CB 76 46 28 05 0E
75ED 12 CD B9 0D 21 36 7F 46
75F5 2E 00 7E D7 23 10 FB FD
75FD CB 76 4E 28 03 3E 0D D7
7605 E1 D1 C1 C9 06 02 CD 6B
760D 76 CD E1 79 38 2E D5 2A
7615 2E 7F ED 5B 32 7F CD E8
761D 79 28 21 38 1F 13 44 4D
7625 E1 00 EB ED B0 18 ED 53
762D 2E 7F C3 FD 76 00 00 06
7635 01 CD 6B 76 2A 2E 7F CD
763D E4 79 30 06 FD CB 30 9E
7645 CF 05 23 FD 36 76 05 E5
764D CD FF 79 21 36 7F 6E CB
7655 3D 26 00 ED 5B 2E 7F 19
765D 22 2E 7F EB C1 C5 ED B8
7665 CD 15 7A E1 18 E1 21 66
766D 77 CD 31 7A 21 B7 7E CD
7675 C5 7A 2E F2 CD C9 7A FD
767D 36 76 00 CD E0 75 3E 20
7685 D7 11 2F 7F CD 8B 7A 3E
768D 0D D7 3E 0D D7 21 2F 75
7695 CD C2 79 FD CB 01 4E FD
769D CB 01 8E CB 21 31 75 01
76A5 04 01 11 2F 7F CD 36 7A
76AD C9 CD 1F 77 3E 0F A3 4F
76B5 CB 01 21 2F 7A 11 18 7F
76BD FD 36 76 0C C5 CD 33 77
76C5 C1 CB 09 CD E1 79 38 20
76CD CD 42 77 20 13 21 18 7F
76D5 ED 5B 34 7F 06 00 C5 ED
76DD B0 C1 ED 53 34 7F 18 E3
76E5 2A 34 7F 23 22 34 7F 18
76ED DA CD 1F 77 3E 0F A3 4F
76F5 CD E1 79 30 08 3E 0D D7
76FD FD CB 30 9E C9 CD 42 77
7705 20 0F E5 CD 85 7A E1 06
770D 03 3E 20 D7 10 FB 22 34
7715 7F 2A 34 7F 23 22 34 7F
771D 18 D6 06 02 21 66 77 CD
7725 31 7A 11 10 7F 21 2D 7A
772D 0E 10 FD 36 76 04 D5 CD
7735 25 7B 3E 0D D7 3E 0D D7
773D D1 CD 74 7A C9 41 11 10
7745 7F 2A 34 7F 1A BE C0 05
774D CB 13 23 18 F7 06 01 21
7755 A6 77 CD 31 7A FD CB 76
775D 9E CD FF 79 CD 15 7A 18
7765 F8 DD E3 EB E3 66 E3 06
776D 02 21 66 77 CD 31 7A CD
7775 BF 79 FD 36 76 03 18 03
777D CD E0 75 CD E1 79 30 05
7785 FD CB 30 9E C9 21 09 7D
778D 36 58 23 36 52 23 36 74
7795 AF 32 36 7F CD 85 7A CD
779D 98 7A 78 FE 76 20 08 21
77A5 F6 7C CD C9 7A 18 D1 FE
77AD CB 28 32 FE ED 28 38 FE
77B5 DD 28 44 FE FD 28 44 CD
77BD EC 79 2E 24 FE 00 28 11
77C5 2E 2C FE 01 28 0E 2C FE
77CD 02 28 09 3E 76 32 08 7D
77D5 2C 7D 81 AF 2A 7D 6E EB
77DD CD F5 78 18 9B CD 98 7A
77E5 CD EC 79 C6 36 18 EC CD
77ED 98 7A CD EC 79 2E 18 FE
77F5 01 28 DE 2E 20 18 DA 3E
77FD 54 18 02 3E 56 21 0A 7D
7805 77 3E 12 28 77 2A 34 7F
780D 23 7E 21 16 7D CD AD 7A
7815 23 CB BE CD 98 7A 78 FE
781D CB 20 05 CD 98 7A 18 BD
7825 CD EC 79 FE 03 28 93 F5
782D C5 FE 00 20 05 3E 06 B8
7835 20 03 CD 98 7A C1 F1 18
783D 81 CD 98 7A AF CB 78 28
7845 01 2F 48 47 2A 34 7F 09
784D EB 21 FE 7C 78 CD AD 7A
7855 23 CB FE 28 28 7A CD AD
785D 7A 18 1F CD 98 7A CB FE
7865 18 17 CD 82 78 18 12 CD
786D 98 7A 23 36 A9 18 08 CD
7875 82 78 23 23 CB BE 28 2B
787D 2B 2B C3 C9 7A 21 FE 7C
7885 CD 98 7A CD FE CD 98 7A
788D C9 78 FE 01 20 10 CD E0
7895 75 21 FD 7D CD C5 7A CD
789D 85 7A CD 98 7A C9 FE 05
78A5 C0 0E 04 CD 93 78 78 FE
78AD 38 C8 CD B4 78 18 F7 0D
78B5 20 E8 0E 04 CD E0 75 18
78BD DE CB 40 20 19 CD D4 78
78C5 13 C9 3E 01 CB 40 20 1E
78CD 18 05 CB 40 28 0F 13 AF
78D5 18 14 CB 40 28 07 13 78
78DD CB 87 0F 18 09 CD DC 78
78E5 13 C9 78 18 01 79 13 62
78ED 6B 6E 26 7C CD CA 7A C9
78F5 1A F5 E6 07 21 FE 78 18
78FD 1E F1 F5 CB 77 28 0D 2A
7905 36 7F CB 55 36 20 23 28
790D F9 22 36 7F E6 38 0F 0F
7915 CB 0F 28 08 21 24 79 E5
791D 26 7D 6F 6E 26 78 E9 F1
7925 CB 7F C0 13 18 CA CD 6B
792D 0D FD CB 02 86 FD 36 76
7935 0E FD CB 30 DE 21 00 7E
793D 06 12 CD C5 7A CD E0 75
7945 10 FB 3E 0D D7 FD 36 76
794D 0C 21 8C 79 0E 02 CD 25
7955 7B 2B 2B 3E 30 BE 20 CE
795D 23 CD 6B 7A 47 07 C6 38
7965 6F 26 7F 7E 23 66 6F E5
796D C5 CD 6B 0D FD CB 02 86
7975 C1 AF 32 36 7F 78 21 10
797D 7E CD CA 7A FD 36 76 02
7985 CD E0 75 3E 0D D7 C9 F8
798D CA 06 02 21 66 77 CD 31
7995 7A CD BF 79 CD E1 79 30
799D 05 FD CB 30 9E C9 CD 85
79A5 7A 3E 20 D7 0E 10 CD 98
79AD 7A 0D 3E 20 D7 0D 28 05
79B5 CD E1 79 30 F1 3E 0D D7
79BD 18 DA 21 DF 79 0E 02 FD
79C5 36 76 0C CD 25 7B 3E 0D
79CD D7 3E 0D D7 21 00 7F CD
79D5 38 7A FE 11 C0 FD CB 01
79DD CE C9 CE D5 2A 32 7F ED
79E5 5B 34 7F A7 ED 52 C9 78
79ED E6 07 4F 78 F5 E6 38 0F
79F5 0F 0F 47 F1 E6 C0 07 CB
79FD 07 C9 01 08 09 3E 20 D7
7A05 10 FB CD 85 7A CD 38 7B
7A0D 3E 0D D7 FD 36 52 FF C9
7A15 ED 5B 34 7F CD 74 7A ED
7A1D 53 34 7F 1B 2A 2E 7F A7
7A25 ED 52 D0 ED 53 2E 7F C9
7A2D 6E 19 78 19 0E 04 11 35
7A35 7F E5 D5 FD 36 76 0C CD
7A3D 25 7B D1 C5 06 02 21 00
7A45 7F CD 5B 7A 12 1B 23 10
7A4D F8 C1 E1 23 23 3E 0D D7
7A55 3E 0D D7 10 DC C9 CD 6B
7A5D 7A 07 07 07 07 F5 23 CD
7A65 6B 7A 4F F1 81 C9 7E D6
7A6D 30 FE 0A D8 D6 07 C9 21
7A75 36 7F 46 CB 38 2E 00 CD
7A7D 5B 7A 12 13 23 10 FB C9
7A85 11 35 7F 21 FC 7C 1A CD
7A8D A5 7A 1B 1A CD A5 7A 3E
7A95 20 D7 C9 21 FC 7C ED 5B
7A9D 34 7F 1A 13 ED 53 34 7F
7AA5 CD AD 7A D7 23 7E D7 C9
7AAD 47 E6 0F CD B8 7A 28 78
7AB5 E6 F0 1F 1F 1F 1F C6 30
7ABD FE 3A 38 02 C6 07 77 C9
7AC5 AF 32 36 7F AF C5 D5 A7
7ACD 28 0B CB 7E 20 03 23 18
7AD5 F9 3D 23 18 F2 CD E0 7A
7ADD D1 C1 C9 ED 5B 36 7F 7E
7AE5 CB 7F 20 05 CD F0 7A 18
7AED F2 CB BF FE 12 38 0C FE
7AF5 5B 30 08 12 13 ED 53 36
7AFD 7F 23 C9 CD FA 7A E5 FE
7B05 0C 30 09 26 7D 6F 6E CD
7B0D E0 7A E1 C9 FE 12 38 05
7B15 26 7D 6F 18 F2 21 0F 7B
7B1D E5 26 7D 6F 6E 26 7B E9
7B25 E5 6E 26 7E CD C5 7A E1
7B2D 23 6E 26 7E CD C9 7A CD
7B35 E0 75 FD CB 76 C6 21 00
7B3D 7F 36 3F CD B7 7B E5 CD
7B45 C0 7B 11 08 5C AF 12 CD
7B4D 54 1F 38 0C CB BE E1 3E
7B55 0D D7 FD CB 30 9E CF 14
7B5D 1A FE 00 28 EA CB BE E1
7B65 FE 0C 20 0A AF BD 28 D1
7B6D CD B5 7B 2B 18 CB FE 0D
7B75 28 26 FE 20 38 CB FD CB
7B7D 76 56 28 10 FE 30 38 BE
7B85 FE 3A 38 0C FE 41 38 B6
7B8D FE 47 30 B2 FE 80 30 AE
7B95 77 79 BD 20 A4 23 18 A1
7B9D FD CB 76 5E 28 04 79 BD
7BA5 20 97 AF BD 28 93 FD CB
7BAD 76 56 28 04 CB 45 20 89
7BB5 36 20 23 22 36 7F CD E0
7BBD 75 28 C9 2A 88 5C 3E 18
7BC5 94 0F 0F 0F 57 E6 E0 5F
7BCD 7A E6 03 57 3E 21 95 21
7BD5 FF 57 19 5F 16 00 19 CB
7BDD FE C9 20 20 20 53 5A 48
7BE5 50 4E C3 20 46 BA 20 41
7BED BA 42 43 BA 44 45 BA 48
7BF5 4C BA 49 58 BA 49 59 BA
7BFD 53 50 BA C2 C3 C4 C5 C8
7C05 CC B9 C1 C1 BA C1 28 5B
7C0D A9 28 5D A9 DF BF D8 DD
7C15 BA BB 7A C3 5D C3 5F EE
7C1D 61 EE 5F C1 61 C1 44 41
7C25 C1 43 50 CC 53 43 C6 43
7C2D 43 C6 B0 B1 B2 B3 B4 B5
7C35 B6 B7 50 55 53 C8 6E 4C
7C3D CC 52 45 D4 63 D8 4A D0
7C45 E5 70 C4 70 C3 53 55 C2
7C4D 53 D8 41 4E C4 58 4F D2
7C55 4F D2 43 D0 50 4F D0 52
7C5D 53 D4 4A D0 A0 EB FA E3
7C65 E3 44 C9 45 C9 BD 90 0E
7C6D 2C C1 67 8E 28 74 29 F2
7C75 5D F2 A0 A0 28 0A A9 74
7C7D F2 E7 E7 A0 E7 A0 A0 A0
7C85 A0 4E DA DA 4E C3 C3 50
7C8D CF 50 C5 D0 CD 5F C3 61
7C95 C3 DF E1 53 4C C1 53 52
7C9D C1 8C 53 DF 42 49 D4 52
7CA5 45 D3 53 45 D4 28 43 A9
7CAD 4E 45 C7 CE C9 53 D8 70
7CB5 C3 49 CD B0 B8 B1 B2 E5
7CBD E5 E5 E5 61 C4 5F C4 49
7CC5 AC 52 AC E7 E7 A0 A0 76
7CCD 2C 76 A7 91 91 F8 F8 F8
7CD5 F8 C1 C1 C9 02 A0 A0 C9
7CDD C4 49 D2 44 D2 E5 43 D0
7CE5 FA EB 4F D4 4E 4F D0 E3
7CED 44 4A 4E DA E9 E9 E9 E9
7CF5 E9 48 41 4C D4 28 30 30
7CFD A9 C3 A9 C7 EA D4 CF DC
7D05 BE D7 E7 00 58 52 74 A0
7D0D 67 6C 74 BE 3E 28 0A 28
7D15 30 30 A9 CB D1 D7 BD 3C
7D1D E5 E8 A3 EB E8 EB EE 92
7D25 82 8A 41 3E 4F F7 3A 44
7D2D 97 A0 4A F1 A8 AB 9C B1
7D35 7C B6 B9 BF C5 87 18 81
7D3D A1 FA 17 00 E0 17 13 7A
7D45 45 00 8A C5 00 F5 59 3E
7D4D 13 77 FA 19 00 48 CC 49
7D55 D8 49 D9 28 0A A9 42 C3
7D5D 44 C5 52 CC 52 D2 45 D8
7D65 4C C4 41 AC 4A D2 4F 55
7D6D D4 43 C1 41 C4 2C BA 53
7D75 D0 41 C6 2C 91 49 CE 62
7D7D 5C 2F 90 B8 6B 58 45 13
7D85 15 AA C5 6A 13 72 45 08
7D8D 07 B2 C5 07 0B 7F E9 B2
7D95 87 CB 7F 46 7E 81 00 D8
7D9D 37 13 6A FA 3E B6 7F BC
7DA5 C4 87 D6 FF 5F AA 7A 38
7DAD B6 92 C5 6A 7F 46 7E 82
7DB5 9E CF 92 00 7A A1 2F BA
7DBD C5 00 7A A4 2F BA C5 00
7DC5 7A A7 2F BA C5 00 7A 63
7DCD 00 92 C5 AA 52 62 AA BA
7DD5 C5 00 50 B2 15 A2 C5 13
7DDD 6A 45 11 13 9A C5 13 11
7DE5 BA 3E B0 FA B6 B8 B9 E2
7DED D8 BC E3 D8 7A 43 B6 92
7DF5 C5 6A 7A 45 00 92 C5 9E
7DFD 5D 46 C2 20 20 20 20 4D
7E05 45 4E D5 20 20 20 20 3D
7E0D 3D 3D BD 30 30 20 50 52
7E15 49 4E 54 20 43 4F 44 C5
7E1D 30 31 20 50 52 49 4E 54
7E25 20 44 41 54 C1 30 32 20
7E2D 50 52 49 4E 54 20 43 48
7E35 52 A4 30 33 20 57 52 49
7E3D 54 45 20 43 4F 44 C5 30
7E45 34 20 57 52 49 54 45 20
7E4D 43 48 52 A4 30 35 20 49
7E55 4E 53 45 52 D4 30 36 20
7E5D 44 45 4C 45 54 C5 30 37
7E65 20 4D 4F 56 45 A0 30 38
7E6D 20 53 45 41 52 43 48 A0
7E75 30 39 20 52 45 50 4C 41
7E7D 43 45 A0 30 41 20 52 55
7E85 CE 30 42 A0 30 43 A0 30
7E8D 44 A0 30 45 A0 30 46 A0
7E95 00 00 00 00 00 00 00 00
7E9D 00 00 00 00 00 00 00 00
7EA5 00 00 00 00 00 00 00 00
7EAD 00 00 00 00 42 52 45 41
7EB5 4B A0 50 52 45 53 45 4E
7EBD 54 A0 4E 45 57 A0 43 48
7EC5 41 4E 47 45 A0 4E 4F 2E
7ECD A0 31 31 20 46 4F 52 A0
7ED5 50 52 49 4E 54 45 52 A0
7EDD 53 54 41 52 54 A0 41 44
7EE5 44 52 45 53 53 A0 46 49
7EED 4E 49 53 48 A0 4C 49 4D
7EF5 49 54 A0 52 4F 55 54 49
7EFD 4E 45 A0
7F2B C3 CF 73
7F36 00 7F 6C 77 8E 79 7C 75
7F3E 52 77 B7 75 34 76 09 76
7F46 37 75 EE 76 AE 76 95 73
7F4E 6C 77 6C 77 6C 77 6C 77
7F56 6C 77
```

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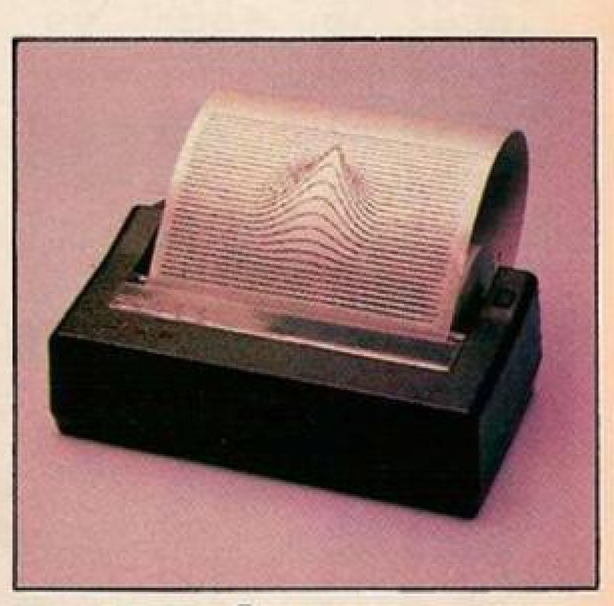
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	Sinclair ZX Spectrum – 48K RAM version	3002	129.95	
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ZX-81 1K

Figure 2. The Starship machine code.

16514	118	118	1	96	1
16519	175	215	11	120	177
16524	32	249	42	14	64
16529	43	34	93	64	229
16534	62	157	1	30	15
16539	215	60	16	252	42
16544	14	64	43	34	95
16549	64	225	205	166	65
16554	42	12	64	30	3
16559	25	34	97	64	62
16564	15	50	99	64	6
16569	16	11	121	176	32
16574	251	17	33	0	42
16579	97	64	229	58	99
16584	64	178	40	37	58
16589	37	64	254	239	32
16594	26	237	82	229	237
16599	75	12	64	237	66
16604	225	56	18	229	33
16609	99	64	53	42	95
16614	64	114	43	34	95
16619	64	225	254	247	32
16624	1	25	229	237	75
16629	93	64	237	66	225
16634	48	95	35	126	254
16639	118	24	2	24	180
16644	32	3	35	35	35
16649	6	3	126	254	136
16654	40	86	43	16	248
16659	35	35	35	34	97
16664	64	227	114	43	114
16669	43	114	225	205	204
16674	65	217	197	217	193
16679	42	100	64	203	65
16684	32	14	42	97	64
16689	43	58	37	64	254
16694	127	32	25	12	6
16699	5	114	25	229	237
16704	91	93	64	237	82
16709	225	56	3	12	24
16714	7	16	3	12	24
16719	2	54	4	197	217
16724	193	217	34	100	64
16729	24	167	225	205	204
16734	65	17	145	65	14
16739	12	24	26	225	17
16744	33	0	54	23	237
16749	82	237	82	54	2
16754	43	54	27	25	25
16759	114	43	54	22	17
16764	157	65	14	9	6
16769	0	33	14	64	52
16774	52	205	107	11	33
16779	125	64	34	41	64
16784	201	184	166	171	170
16789	0	177	166	179	169
16794	174	179	172	23	23
16799	168	183	166	184	173
16804	23	23	17	33	0
16809	43	229	42	123	64
16814	43	124	254	24	56
16819	2	38	24	126	34
16824	123	64	225	230	7
16829	60	71	229	54	136
16834	237	82	16	250	225
16839	43	13	32	223	201
16844	54	46	43	54	156
16849	43	54	130	201	

THESE TWO programs tease yet more out of the valiant 1K ZX-81. Economy is a vital point of good software, and is often synonymous with efficiency. Some might argue that Sinclair's 1K machine has contributed more than any other computer to developing this aspect of programming.

Both programs have a familiar general form, but boast a few extra features of interest. In Starship, your craft is in trouble, circling

```
1 REM 339 BYTES OF MC
2 INPUT A$
3 CLS
4 RAND USR 16516
```

Figure 1.

lower and lower over an enemy city, frantically trying to blast clear an area in which to land. A limited amount of fuel allows the pilot occasionally to gain attitude to clear high buildings.

At the bottom of the display the fuel guage enables you to calculate your descent to a nicety. Even the slightest contact with a building causes a graphic explosion.

With skill the spacecraft may be put down in a small area surrounded by buildings. Keys 1 to 5 take the ship up, 6 to 0 take it down. B of course, releases bombs. At the end of each game, a single keypress restarts.

To enter the machine code type:

```
1 REM 109 characters
```

Check the length of line 1 by typing

```
PRINT PEEK 16511
```

the answer to which should be 111. If it is not, then edit and adjust accordingly. Having done this, edit line 1 twice, changing the line number to 2 and 3 in turn. Now type:

```
POKE 16511,85
POKE 16512,1
POKE 16510,0
```

The last statement prevents your accidentally erasing the line at some later stage in the proceedings. Next, use the following loader program to enter the Starship machine-code dump shown in figure 2.

```
10 FOR N=16514 TO 16852
15 SCROLL
20 PRINT N;
25 FOR K=0 TO 4
30 IF N+K=16853 THEN STOP
35 INPUT I
40 POKE N+K,I
45 PRINT TAB 6+K*5;I;
50 NEXT K
55 PRINT
60 NEXT N
```

If you make a mistake entering the code, stop the loader routine by returning an unused variable name to the prompt for I; change the first address in line 10 to that at which the error was made, and start again from the appropriate point in the dump.

Finally, type in lines 2 to 4 of figure 1, delete the loader routine, and save the program on cassette.

The second program is a zippy version of Breakout. It has the considerable advantage of showing you at the top left of the screen how many of the six available balls have been used up, and at the same time displaying at the bottom left the running score.

Scoring is at the rate of one point per outer brick of the double wall, two for each of the inner bricks, giving a maximum score of 108. any key, 1 to 5, will move the bat down, while any of 6 to 0 moves it up. The score is updated with each new ball. As in the case of Starship, a single keypress restarts at the end of a game.

To type in Breakout, use the same technique outlined for Starship to prepare the large Rem statement for the machine code. On this occasion, however, line 1 should contain 120 characters, giving 122 as the result for

```
PEEK 16511
```

Having copied this Rem statement into lines 2 and 3, type the following statements:

```
POKE 16511,118
POKE 16512,1
POKE 16510,0
```

Use the same loader routine to enter the bytes, changing the second address in line 10 to 16885, and the terminating address in line 35 to 16886. When the dump of figure 4 has been successfully entered, delete the loader again, type in lines 2 and 3 of figure 3 and save it.

In Breakout, speed of play is in inverse proportion to the number stored at location

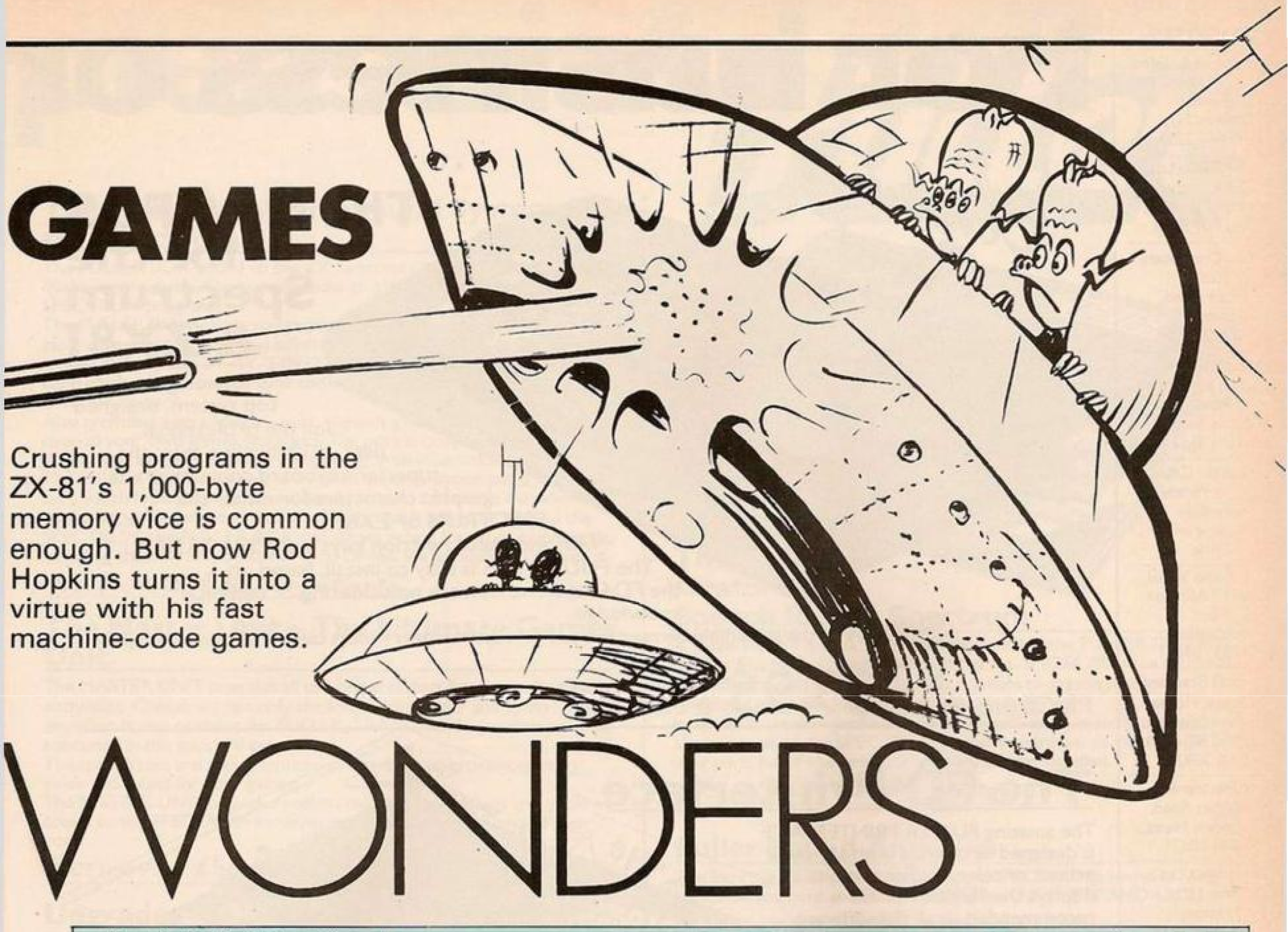
```
1 REM 372 BYTES OF MC
2 LLPRINT
3 PAUSE USR 16573
```

Figure 3.

16564. A value of 3 gives a very fast and difficult game; 12 is for beginners.

Owners of 16K machines, incidentally, must first reset RAMtop before running these programs. The following direct statements would serve:

```
POKE 16389,69
NEW
```



GAMES WONDERS

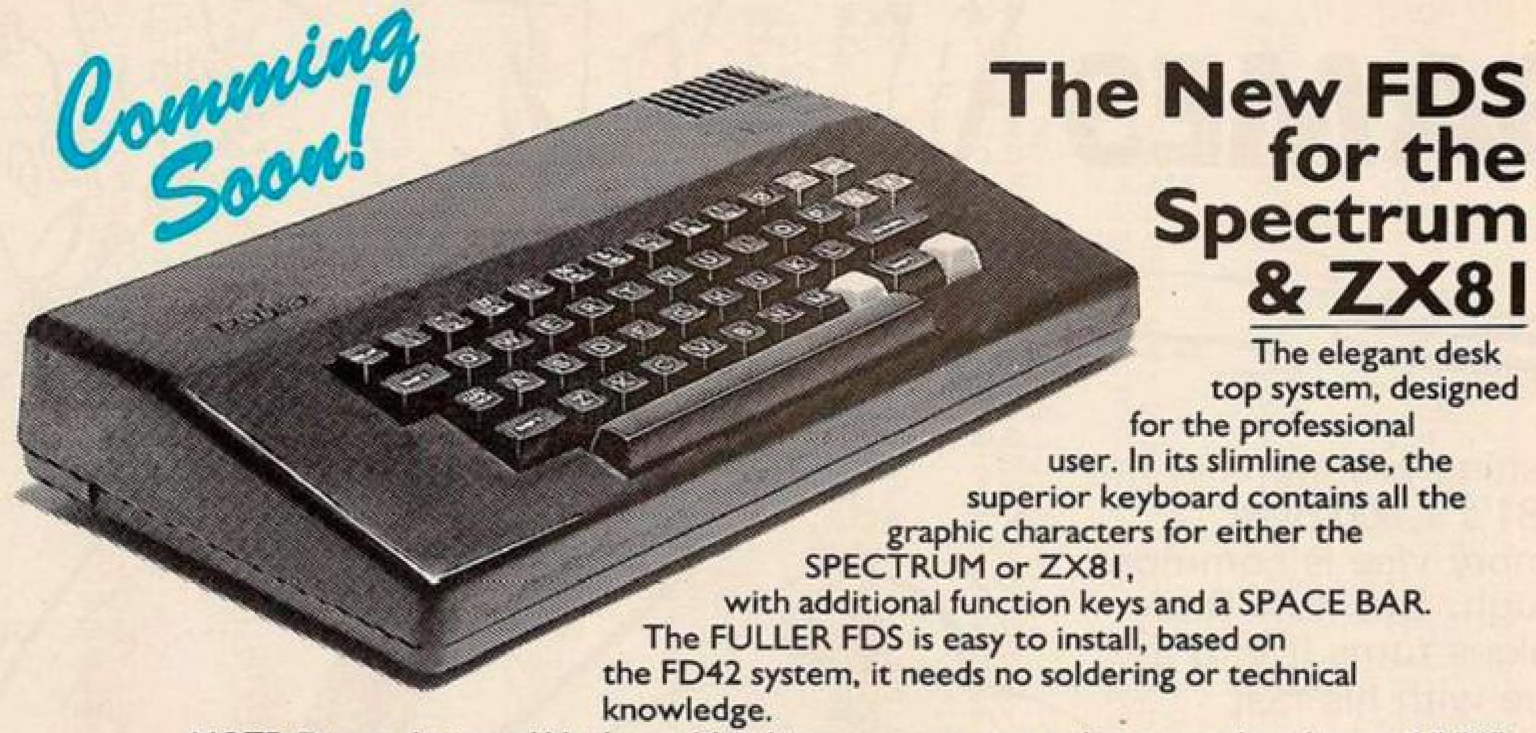
Crushing programs in the ZX-81's 1,000-byte memory vice is common enough. But now Rod Hopkins turns it into a virtue with his fast machine-code games.

Figure 4. The Breakout machine code.

16514	118	118	197	245	205
16519	245	8	42	14	64
16524	86	241	215	193	201
16529	175	190	32	3	52
16534	52	201	53	53	201
16539	62	11	165	32	1
16544	13	62	0	185	192
16549	12	201	111	38	0
16554	229	205	245	8	225
16559	205	171	10	201	6
16564	8	14	255	13	32
16569	253	16	249	201	62
16574	131	1	26	13	205
16579	132	64	16	251	6
16584	0	205	132	64	6
16589	13	205	132	64	13
16594	32	243	14	20	6
16599	12	62	149	205	132
16604	64	16	251	13	121
16609	254	17	32	241	6
16614	12	62	8	205	132
16619	64	16	251	13	121
16624	254	14	32	241	253
16629	54	62	2	253	54
16634	65	0	58	52	64
16639	230	11	254	2	56
16644	247	253	119	124	58
16649	52	64	230	2	203
16654	71	32	247	253	119
16659	60	253	54	61	2
16664	253	78	62	58	37
16669	64	254	247	32	3
16674	12	24	5	254	239
16679	32	4	13	205	155
16684	64	253	113	62	42
16689	12	64	35	35	229
16694	6	12	17	28	0.

16699	25	114	16	251	225
16704	6	3	25	13	32
16709	252	54	133	25	16
16714	251	205	179	64	237
16719	75	123	64	175	185
16724	40	72	205	132	64
16729	17	124	64	253	126
16734	60	126	61	71	16
16739	27	253	126	61	129
16744	61	79	18	62	52
16749	205	132	64	120	33
16754	60	64	254	1	40
16759	68	254	12	40	64
16764	121	254	25	40	64
16769	254	0	40	25	122
16774	254	133	40	55	30
16779	1	254	6	40	5
16784	254	149	32	132	28
16789	253	126	64	131	253
16794	119	64	24	35	253
16799	52	65	253	54	61
16804	2	175	205	132	64
16809	58	54	64	1	2
16814	13	17	182	65	213
16819	205	167	64	253	54
16824	123	8	24	12	205
16829	145	64	24	187	35
16834	205	145	64	195	24
16839	65	42	12	64	35
16844	58	65	64	198	156
16849	119	254	163	194	252
16854	64	33	125	64	34
16859	41	64	33	14	64
16864	52	17	237	65	1
16869	9	0	205	107	11
16874	6	155	201	44	38
16879	50	42	0	52	59
16884	42	55			

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MICRO SYSTEMS

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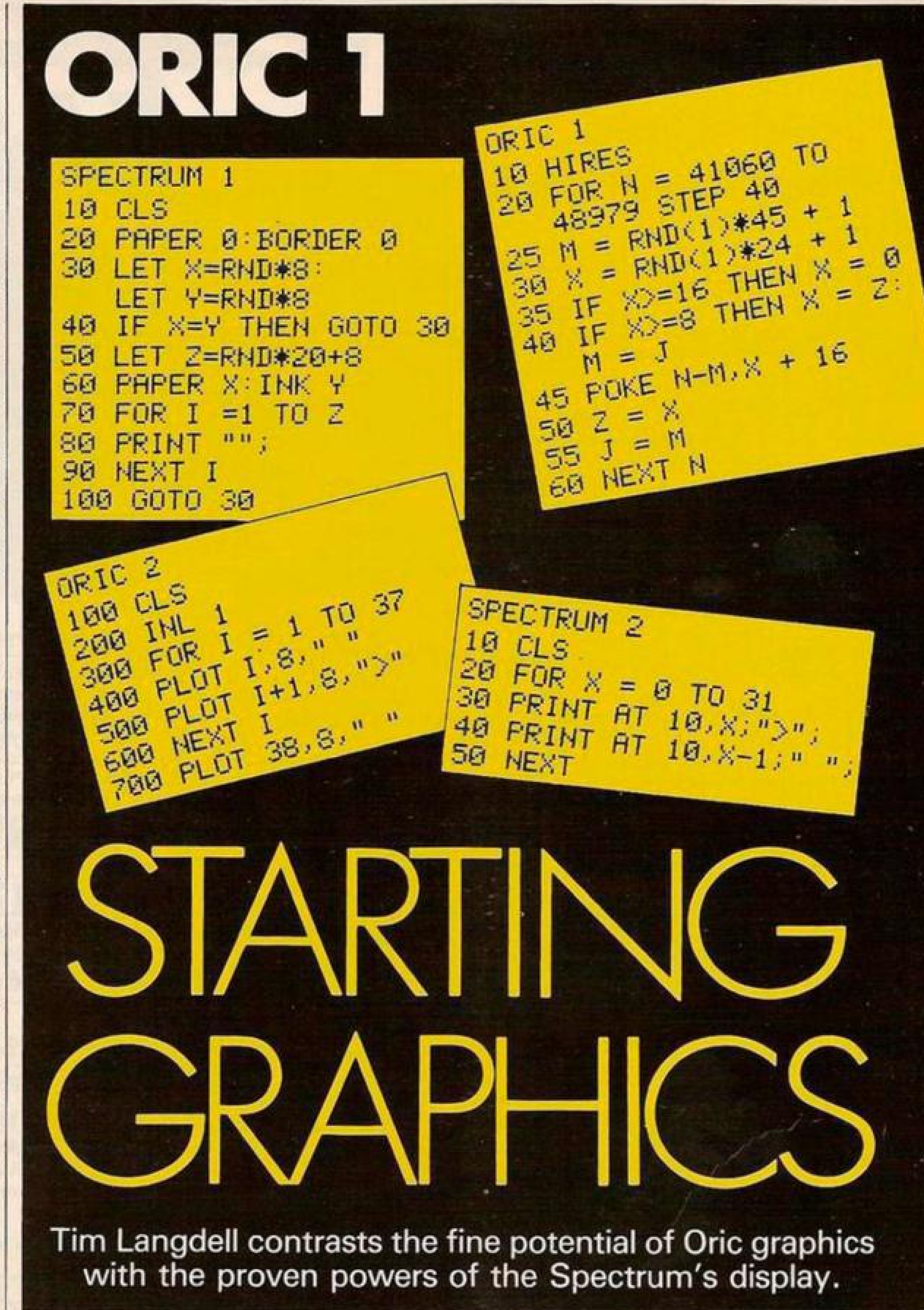
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STARTING GRAPHICS

Tim Langdell contrasts the fine potential of Oric graphics with the proven powers of the Spectrum's display.

ON THE FACE of it both the Oric 1 and the ZX Spectrum have similar graphics and colour capabilities. Both have a similar maximum resolution — the Spectrum has 256 by 175, and the Oric 240 by 200 and both are able to draw lines, circles and plot points. Both can have a maximum of eight colours on the screen at the same time. What, then, are the main differences between these two highly competitive machines?

As far as colour capability is concerned, the major difference between the two machines is that whereas the Spectrum uses a parallel-attribute system, the Oric uses a serial one. In practice, this means that the Spectrum has a separate map or file of the screen's attributes.

These attributes include its possible eight Paper, or background, colours; its eight Ink, or foreground, colours; brightness and flashing. The advantage of this system is that the attribute file is quite independent from the screen display itself, and can be manipulated independently. The Spectrum's attributes act over a character square on the screen eight pixels wide by eight pixels high.

Serial attributes

The Oric's serial attribute system means that a physical character square on the screen acts to inform the computer what colour the rest of the characters on that line should be. An attribute square on the Oric's screen affects all the rest of the bytes on that line until another attribute byte is encountered. With the Oric is you wish to have six blue balls in a row followed by six red ones a character square gap is needed between the two sets of balls to redefine the attributes of the second set as red rather than blue. Note, though, that the Spectrum is mapped in character squares, whereas the Oric's screens attributes are byte-wide single-pixel width lines. To see more clearly what this means Oric owners might like to type in program Oric 1 — multicoloured lines — and note that each pencil-thin line on the screen can be a different colour. However, the Spectrum's colour resolution in this horizontal plane is much chunkier — even when alternating Ink and Paper colours are used to give coloured stripes on the screen: see program Spectrum 1.

The net result of this is that the Oric has the potential of having multicolour characters — in terms of the horizontal lines which make them up — but requires a whole character square gap between different coloured graphics. On the other hand the Spectrum can only have two colours in any given character square, but is not limited to having a gap between characters. Needless to say, one is not a clear winner over the other in these respects, although writing games on the Oric may prove difficult if graphics characters are not to overwrite the attribute characters of other graphics on the screen.

The line drawing capabilities of both machines are pretty similar. They are both relative drawing routines insofar as they draw to a new X and Y co-ordinate from the last point plotted. Whereas the Spectrum has a third parameter which can follow arc, the Oric lacks any such capability. For its part, the Oric has a third parameter which allows one to state whether the line should be drawn in the current Ink colour, the current Paper colour or Exclusive Or with what else is on the screen. These features are available on the Spectrum separately in the form of the Inverse and Over features.

The Oric features two main ways of moving the graphics cursor around the screen, whereas the Spectrum has only one — namely the absolute Plot command at specified X-Y co-ordinates. The Oric uses Curset to achieve this absolute determination of a position, but also featues Curmov which allows you to define a specified displacement from your last position. The Oric also allows you to print a character on the graphics screen according to pixel Plotting X-Y co-ordinates, rather than according to the 24 rows and 40 columns usually used in the Text mode. This is not only useful for putting text on the graphics screen of the Oric but also allows subscripts, superscripts and high-resolution movement in Basic without resort to fantastic tricks. On the Oric the text and so-called high-resolution screens are separate.

Program Oric 2 shows how the Oric can easily move a single character across its graphics screen one pixel at a time, or two pixels, and so on enabling you to trade off between speed of movement and smoothness in writing a game using this feature.

Speed and smoothness

To obtain similar high-resolution movement on a Spectrum from Basic one needs to resort to tricks. For instance, you can calculate how to Poke the necessary bytes directly to the screen — no mean feat with the Spectrum's complex screen format — or set up a column



of 21 user-defined graphics which are all blank except the first, which is the character you wish to move. You can then shift the bytes which make up the characters along one location in memory where the user-defined graphics are held and re-print them to the screen. The result is a smoothly-falling character. Horizontal movement is rather more difficult though. See program Spectrum 2 for an example of this method.

The Oric has two character sets which are both in RAM, and which can both be redefined. This gives a total possible number of user-defined graphics of over 500. At first glance the 21 user-definable graphics on the Spectrum seems paltry in comparison — but in fact considerably more than 500 user-definable graphics can be created with the Spectrum if the tricks to do so are known. In fact, creation of user-defined graphics is really only limited by RAM available. The Spectrum has two addresses in its systems variables — 23606, 23607 — which hold the address of the character-set table — the numbers which the computer uses to create each character. By Poking different values into these locations one can get the Spectrum to read its character set from anywhere in RAM — and thus have many blocks of 256 characters.

Creation of the UDGs themselves is easily done on the Spectrum if one is willing to stick to just 21. This machine offers a

USR " "

feature which allows you to program new characters without having to know the exact locations in RAM where the bytes are to be stored. However, when using the above method for many more characters then both machines require that you know where the character table starts in memory and Poke bytes to this table in carefully calculated blocks of eight bytes.

The Oric has slightly more limited user-defined graphics because only six of the eight pixels in a line of the character can be used. The other two are used to tell the Oric that the byte refers to pattern information rather than attribute information.

All in all, both machines offer an excellent range of facilities to those interested in colour graphics, with the Spectrum having the edge — just — for its ease of programming and using the colours. Time will tell as to whether the Oric's serial attribute system leads to major difficulties in commercial games writing of the excellence so far achieved on the Spectrum. ■


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48K SPECTRUM SPEAKS

No hardware add-ons, just your faithful cassette recorder — John Edwards makes micros talk.

IT IS popular belief that to get a personal computer to speak requires an expensive hardware add-on. This program, written for the ZX-Spectrum will prove otherwise.

Unfortunately the program will only work effectively on a 48K machine, because a lot of memory is required to store any useful amount of speech with sufficiently high fidelity.

The speech is recorded and generated by two extremely short machine-code routines, which take only a few moments to enter. To obtain maximum storage capacity each byte of memory is used to store eight pieces of speech information as opposed to one.

In the following routines the following rule applies: the longer the piece of speech the lower the fidelity. This means that if the short phrase "Good morning" is required, then the fidelity will be high, but if the computer is required to count from one to 100 the fidelity will be so low that the speech will be nothing but indecipherable grating.

The routines are designed to store speech above 32768 which means that if speech is used the user is left with the equivalent of a 16K machine.

The machine code is entered by first typing and running the program in figure 1 which allows machine code to be entered in hexadecimal form.

Run the program and Enter 65280 to the prompt, then enter the hexadecimal code line by line pressing Enter after each line of code.

After you have finished typing in the hexadecimal code just press Enter and the program will stop with an error. Save the machine code with

SAVE "SPEECH"CODE 65279,100

Then type

CLEAR 32767

and New; the program will disappear but the machine code will remain intact. As the routine standard you have about six seconds of recording time.

Set up your cassette recorder to record sounds through a microphone and record something clearly and plainly onto tape. It will be easier if you make a noise before you start so that you will be able to locate your speech easily. Then play your piece of speech through and adjust tone and volume to minimise tape noise.

When you are ready type

RANDOMISE USR 65280

but do not press Enter. Plug the Ear lead between the tape recorder and your computer then start the tape playing. When you hear the noise that precedes your speech through the computer's loudspeaker press Enter.

After about six seconds a report code should appear at the bottom of the screen and when this happens you can stop the tape recorder. You can now test the speech by typing

RANDOMISE USR 65308

If the speech is not very clear then repeat the process of recording with different levels. You will find that the speech sounds better if you connect the Mic lead to an external amplifier.

If you cannot get the machine code to work, reload it and check it through, by Peeking the locations from 65280 onwards.

Any speech recorded by the program can be Saved by

SAVE "SPEECH"CODE 32767,65279-32767

and Load by

LOAD ""CODE

The program can also be used for realistic sound effects.

Figure 1.

```
  10 DEF FN k(x)=CODE "012345678
90000000:;<=>?0000000000000000000
00000000:;<=>?"(CODE a$(x)-47)-48
  15 REM <=> are three characters
  20 LET a$=""
  30 INPUT x
  40 IF a$="" THEN INPUT a$
  50 POKE x,16*FN k(1)+FN k(2)
  55 PRINT x,a$( TO 2)
  60 LET a$=a$(3 TO )
  70 LET x=x+1
  80 GO TO 40
```

Figure 2. Machine-code listing

```
HEX                 MNEMONICS

F3          HEAR    DI
210080              LD HL,32768
0608        HLP1    LD B,8
```



```
DBFE        HLP2    IN A,(254)
CB77                BIT 6,A
2002                JR NZ,2
CBFE                SET 7,(HL)
CB3E                SRL (HL)
10F4                DJNZ HLP2
CB0E                RRC (HL)
23                  INC HL
7C                  LD A,H
FEFE                CP 254
20EA                JR NZ,HLP1
FB                  E1
C9                  RET
F3          TALK    DI
210080              LD HL,32768
0608        TLP1    LD B,8
CB46        TLP2    BIT 0,(HL)
2804                JR Z,4
3E00                LD A,0
D3FE                OUT (254),A
3EFF                LD A,255
D3FE                OUT (254),A
CB06                RLC (HL)
10F0                DJNZ TLP2
CB06                RLC (HL)
23                  INC HL
7C                  LD A,H
FEFE                CP 254
20E6                JR NZ,TLP1
FB                  EI
C9                  RET
```

■

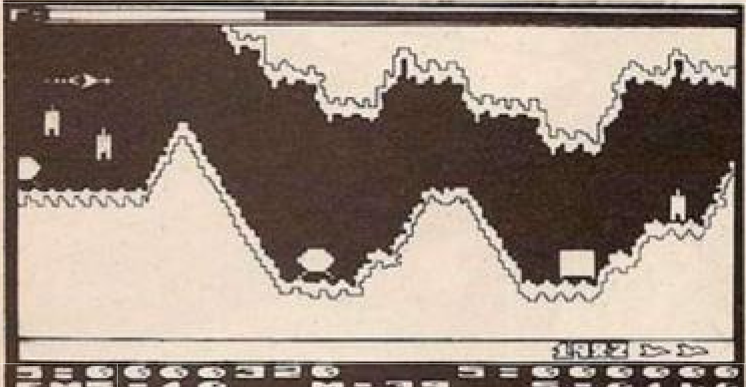
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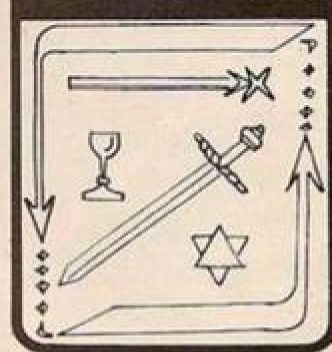
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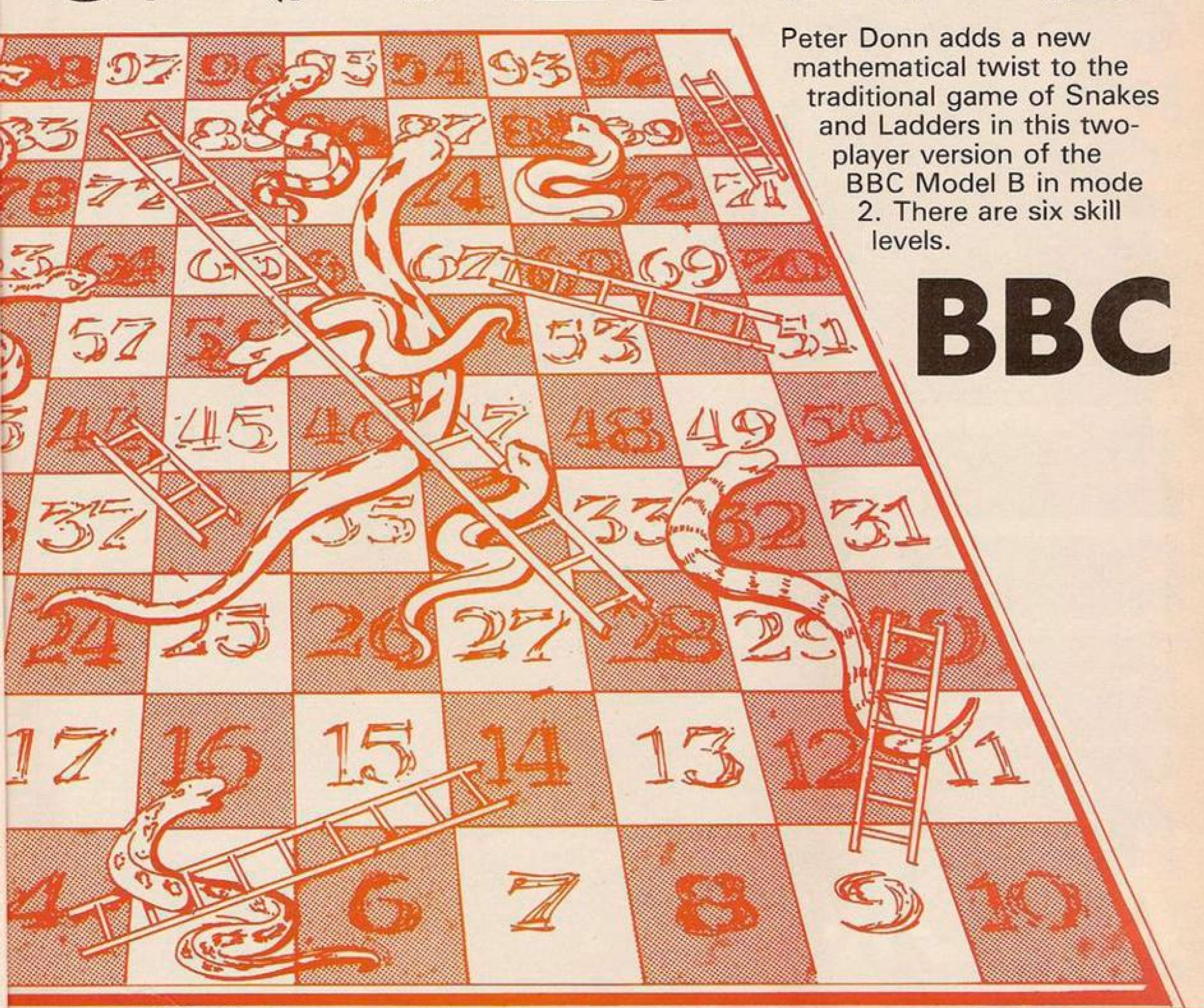
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SNAKES AND LADDERS

Peter Donn adds a new mathematical twist to the traditional game of Snakes and Ladders in this two-player version of the BBC Model B in mode 2. There are six skill levels.

BBC



WHAT IS THE appeal of Snakes and Ladders? Does it lie in its ability to mirror the unpredictable ups and downs of life — or is it a throwback to Biblical times when snakes could be relied upon to lead you astray?

Whatever the case may be, I have developed a complete representation of this game on the BBC Model B computer which utilises its colourful graphics to the full potential and likewise the sound capabilities. One substantial feature has been added to the game. There are mathematical questions, the difficulty of which is stated at the start. This educational Snakes and Ladders is ideal for those between the ages of 2 and 16.

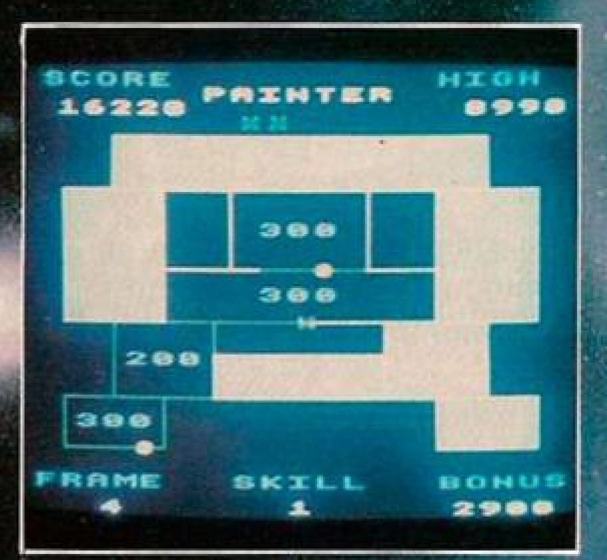
The program is split up into two parts which are loaded one after the other. This is simply because of the lack of memory on the BBC Model B using mode 2. The first part is concerned mainly with the definition of graphics characters, and there are quite a few of them.

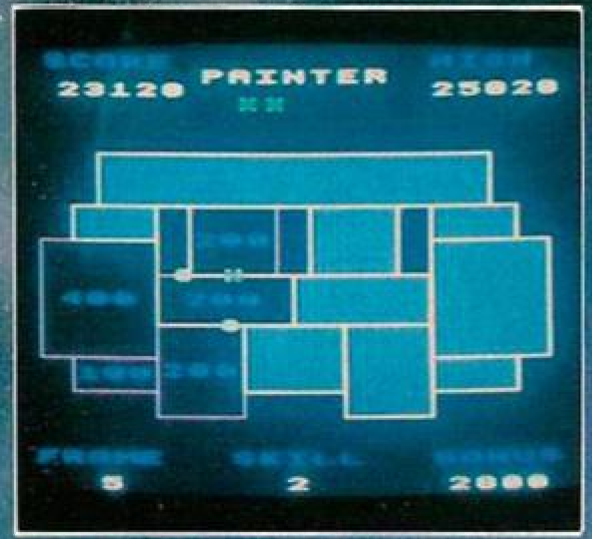
The game is for two players and when Run asks them for their names. You then choose the difficulty level: level 1 is the easiest, and level 6 is the hardest. It is still possible to get easy questions on level 6 though, because the level decides on the range of values the computer chooses from when deciding on the question to give you.

(continued on page 115)

32K BBC ALL O.S.'s







PAINTER Written entirely in machine code this fast arcade style game features sixteen different screen presentations and six skill levels which make the game harder as you get better. **£8.00**



PLANES Another A&F machine code special. Select either 'fast' or 'slow' and stand by your keyboard for action. Hi-score tables and brilliant graphics **£8.00**

FROGGER Also written in machine code this is a frustrating exercise in crossing the road, fording a river and trying for extra points by picking up the lady frog. Brware of the snake and don't forget the crocodile! **£8.00**



TOWER OF ALOS An excellent adventure game which has the feature of saving your character if you want to. Also for the Model A. **£6.90**

PHARAOH'S TOMB The interactive adventure game for the BEEB. Pick up the gold pieces, fight the spider and be scared penniless by the mummy. Work out the magic words and you are on your way. **£8.00**

LUNAR LANDER One of our old favourites and still just as difficult to get down in one piece. **£6.90**

ATOM

SPACE PANIC & PAINTER The best excuse for keeping your ATOM. Space Panic got a 99% review in PCT (Dec. 82) an d will keep you at the keyboard for hours.

Painter — the original program — was the arcade version based on this? It got a 90% review in PCT (Jan. 83)

BOTH GAMES ARE £6.90 EACH

Also available for the ATOM:

Cyclon Attack 3D arcade type space battle (87% review in PCT April 83) **£6.90**
Death Satellite & Zodiac Two superbly frustrating adventure games **£6.90 each**

ATOM UTILIKIT adds hi-speed COS and many extra commands and features (see review in December 82 Acorn User) **£18.50**

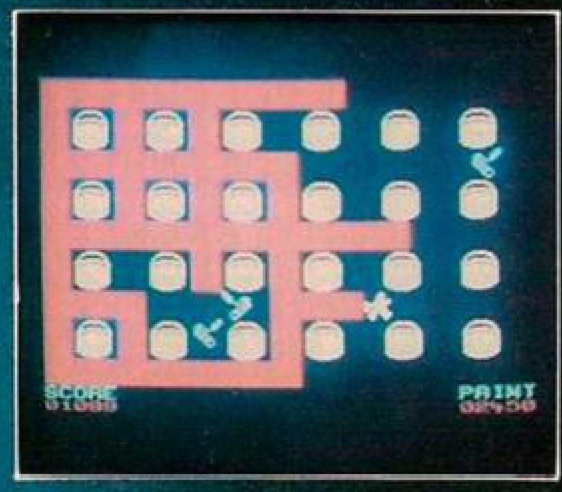
A + F SOFTWARE 06

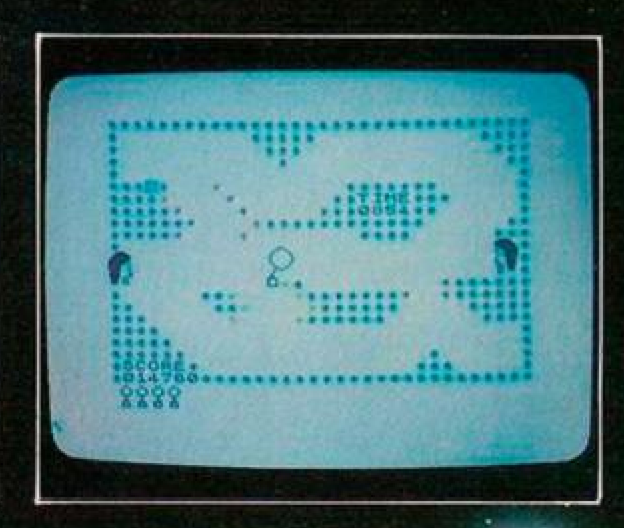
DRAGON 32

DEADWOOD Monopolise a western town with this multiplayer game. Up to four may play together, set their own time limit and look after their money knowing that when the time is up the computer will stop the game, calculate the results and tell who has won **£6.90**

SPECTRUM







48K SPECTRUM FROGGER Fast action arcade style game written in machine code and very addictive **£5.75**

48K SPECTRUM PAINTER Another machine code addictive game. The graphics have to be seen to be believed **£5.75**

CRAZY BALLOONS Will run on either machine (16 or 48K). Starts off nice and easy and gets very hard **£5.75**

SPECFILE A new DATA management system written especially for the SPECTRUM. Ideal for stock control, inventories, filing and data storage **£10.00**

ORIC

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YC1

(continued from page 111)

As you watch the display being built up, you will see that there is a border around the edge, the main board on the left two-thirds of the screen, and each player's dice and score on the top-right and bottom right of the screen. On the left-hand side of the screen, in the border, is displayed the current skill level.

A question — adding, subtraction, multiplication or division — is given as someone is about to go up a ladder or down a snake. You have eight seconds to answer a question. Once a number is typed it cannot be deleted. Should you finish before the time is up, pressing the space-bar will continue the program. Getting the question right will either allow you to go up a ladder or not go down a snake, depending on your position.

Just in case the program does not make it clear, to roll your dice press D. Your dice will roll a few times with the appropriate sound effects. You are then asked if you are ready to move. If you are, press Y. If you are lucky enough to get a six on your dice, you can have another go. The winner is the first person to jump off the last square of the board, at the top right. The program then plays *For He's a Jolly Good Fellow*, and the players can decide if they want another go. If so, 1 is added to their score — displayed on the screen — and the game is restarted, with an option to change the skill level again. If not, new players can play, and the game is automatically run again.

```
   10 REM****** SNAKES & LADDERS ******
   20 REM******    COPYRIGHT     ******
   30 REM******   PETER DONN     ******
   40 REM******   AUGUST 1982    ******
   50
   60 MODE2
   70 *FX11,0
   80 *FX9,10
   90 *FX10,10
  100 ENVELOPE1,1,1,1,-1,10,10,20,0,0,-1,-2,126,100
  110 ENVELOPE2,5,10,-10,10,3,3,3,0,-1,-2,-3,126,126
  120 VDU23,224,0,0,4,2,255,2,4,0,23,225,0,0,32,64,255,64,32,0,23,226,126,249,24
9,175,3,83,255,255,23,227,126,159,159,245,192,202,255,255,23,229,15,15,31,61,60,
120,96,128,23,228,240,240,248,124,60,22,6,1,23,230,0,0,0,24,24,0,0,0
  130 VDU23,231,24,126,90,219,126,102,90,129,19,0,2,0,0,0,19,2,0,0,0,0,23,232,0,
0,0,0,0,0,24,24,23,233,24,24,0,0,0,0,0,0,23,234,0,0,96,96,96,96,0,0,23,235,0,0,6
,6,6,6,0,0,23,236,192,192,192,192,0,0,24,24,23,237,24,24,0,0,3,3,3,3
  140 VDU23,238,195,195,195,195,0,0,0,0,23,239,0,0,0,0,195,195,195,195,23,240,19
5,195,195,195,0,0,24,24,23,241,24,24,0,0,195,195,195,195,23,242,195,195,195,195,
0,0,195,195,23,243,195,195,0,0,195,195,195,195
  150 VDU23,244,24,24,0,255,0,24,24,0,23,245,66,102,36,24,36,102,66,0
  160 PRINTTAB(2,8);"PART ONE LOADED"
  170 PRINTTAB(10,18);"for part 2";CHR$11;CHR$11
  180 CHAIN"Sn+La"


LIST
    5 REM SNAKES AND LADDERS PART 2 - (C) PETER DONN '82
   10H%=0:J%=0:DIM A(4,65):MODE2
   20A=0:TIME=0:CLS:MO=1:RN=0:TR=0:RN2=0:TR1=0:POS1=0:POS2=0:U$=CHR$8+CHR$10:RES
TORE
   30IFH%>0ORJ%>0THEN80
   40COLOUR2:GCOL0,1
   50PRINTTAB(2,8);"WELCOME";TAB(12,8);"TO":VDU5:GCOL0,1:Q=INKEY(100)
   60Y$=" S N A K E S   A N D   L A D D E R S":FORX=1TO39:MOVEX*1280/40,(300*SIN(
X/6))/2+800:PRINTMID$(Y$,X,1):NEXT:GCOL0,3:INPUT''''''"ENTER PLAYERS NAMES:"'''
"1)  "Z$,'"2)  "Y$
   70PROCSK:IFRND(2)=1A$=Z$:B$=Y$ELSEA$=Y$:B$=Z$
   80VDU4:CLS:VDU5:GCOL3,1:MOVE0,80:PRINT"   WAIT PLEASE":@%=0
   90VDU19,0,2,0,0,0,19,2,0,0,0,0
  100GCOL0,6:MOVE100,112:MOVE100,912:PLOT85,980,912:MOVE980,112:PLOT85,100,112:G
COL0,5:FORY=113TO912STEP200:FORX=101TO980STEP220:PROCdraw:NEXT:NEXT
  110FORY=213TO912STEP200:FORX=211TO980STEP220:PROCdraw:NEXT:NEXT
  120GCOL0,7:FORY=143TO942STEP200:FORX=872TO101STEP-110:A=A+1:A(1,A)=X+2:A(2,A)=
Y+35:MOVEX+25,Y:PRINTCHR$225:NEXT:A=A+8:NEXTY:A=8
  130FORY=243TO1042STEP200:FORX=101TO871STEP110:A=A+1:A(1,A)=X+2:A(2,A)=Y+35:MOV
EX+25,Y:PRINTCHR$224;:NEXT:A=A+8:NEXT
  140FORSN=1TO12:PROCSNAKES:NEXT:FORHEAD=1TO4:READHX,HY:MOVEHX,HY:PRINTCHR$226:N
EXT
  150MOVE761,840:PRINTCHR$227:MOVE211,540:PRINTCHR$227:MOVE651,313:PRINTCHR$228:
MOVE321,713:PRINTCHR$228:FORTA=1 TO 4:READTX,TY:MOVETX,TY:PRINTCHR$229:NEXT:FORL
A=1TO7:PROCLADDERS:NEXT:GCOL0,1:PROCGAME
  160IFPV=813 Z$=A$:H%=H%+1 ELSEZ$=B$:J%=J%+1
  170VDU19,0,12,0,0,0,19,2,2,0,0,0:GCOL0,2:MOVE200,450:MOVE200,750:PLOT85,830,75
0:MOVE830,450:PLOT85,200,450:GCOL0,15:COLOUR15:VDU4:PRINTTAB(5,10);"WINNER";TAB(
7,12);"IS";TAB(8-(LEN(Z$))/2,14);Z$:VDU4
  180RESTORE900:FORM%=1TO31:READP%,L%,C%:IFC%<>0PROC802
  190SOUND1,-15,P%,L%*3:FORT%=0 TO L%*1000:NEXT:NEXT:*FX15,7
  200FORZ=0TO100:NEXT:MIN=(TIME DIV 6000)MOD 60:SEC=(TIME DIV 100)MOD 60
  210VDU20,4:CLS:COLOUR6:PRINTTAB(2,2);"DURATION OF PLAY:";TAB(3,4);MIN;" MINS
":SEC:" SECS"
  220COLOUR2:PRINTTAB(3,7);"WOULD YOU LIKE"'TAB(4,9);"ANOTHER GAME";TAB(9,11);"?
":X$=GET$
  230IFX$<>"Y"THEN250
  240PRINTTAB(0,25);"    Same players?":X$=GET$:IFX$="Y"PROCSK:Z$=A$:Y$=B$:GOTO2
0 ELSE CLEAR:H%=0:J%=0:RUN
  250IFX$<>"N"COLOUR12:PRINTTAB(3,18);"ANSWER PROPERLY";TAB(7,15):"PLEASE":A=INK
EY(200):CLS:GOTO220 ELSE MODE7:PRINT'"BBC Computer"''"BASIC"':END
  260DATA415,215,424,200,439,258,452,246,452,246,452,258,312,330,304,313,848,208
,864,196,896,347,927,335,927,335,899,317,848,515,868,526,653,296,666,312,174,383
,185,405,185,405,204,402,234,518,209,533
  270DATA519,410,532,396,581,457,562,467,583,454,559,454,478,678,504,682,504,667
,484,680,765,828,782,813,748,512,760,500,818,670,795,670,818,670,804,658,746,712
,754,724,320,700,336,712,326,824,311,815
  280DATA261,345,811,540,701,740,261,840,371,213,811,213,481,413,701,513,599,189
,639,175,801,319,775,342,167,292,194,270,464,524,441,548,611,401,638,384,688,526
,667,544,883,472,916,495,861,740,829,716
  290DATA166,597,197,579,483,822,441,841,551,581,579,598,526,750,495,720,226,773
,255,801,198,842,174,824,23,6,34,2,39,14,51,30,63,21,58,43,4,18,9,37,20,35,32,50
,36,53,40,60,55,57
  300 DEFPROCdraw:MOVEX,Y:MOVEX,Y+100:PLOT85,X+110,Y+100:MOVEX+110,Y:PLOT85,X,Y:
ENDPROC
  310DEFPROCSNAKES:GCOL0,1:READX,Y,X1,Y1,X2,Y2,X3,Y3:MOVEX,Y:MOVEX1,Y1:PLOT85,X2
,Y2:MOVEX3,Y3:PLOT85,X,Y:ENDPROC
```

(listing continued on next page)

Playing the game

Firstly, type in program 1. Run it to see if it works — and make sure it does. All it displays is a green mode 2 screen, and some writing saying that the first part is loaded and the computer is ready for the second part. Save the program on cassette calling it:

SN&LA

Now press Break and type in the second program. Do not run this but save on tape calling it:

SN + LA

Now press break and type:

```
PAGE = &D00  (return)
NEW          (return)
```

This is to give access to a further 256 bytes of memory which is not being used. Type this also before loading the game in future.

Chain the first program and continue to load the second program which should have been saved on tape after the first program. Any errors in the second program can now be dealt with. Do not at any time press Break. If you do this, you will be greeted by

BAD PROGRAM

If you do — type:

```
PAGE = &D00  (return)
?&E00 = 65   (return)
?&E01 = 65   (return)
```

and the program can now be listed. But you will find that after the first page of memory there are two letter As, which seem to have appeared from nowhere. You will have to correct that part of the program. It makes things that much easier if you do not press Break. To make correcting errors easier, type Mode 7 after the error report, and Print ERL. Alternatively, add the following line at the start, and delete it once the program is running correctly:

```
5 ON ERROR MODE7:PRINT''':REPORT:
PRINT" at line ";ERL:END
```

For the sake of those people who are interested in the BBC features used in the program and some of the techniques involved in the production of the program, and also those people who are mad enough to want to try to convert the program to work on another computer, here is a breakdown of the program.

Program outline

Program 1, line 70 sets up the delay time in the auto-repeat function of the keys. Lines 80 and 90 set up the colour flash rates. 100 and 110 define sound effect envelopes. Lines 120-150 store character definitions in memory locations &C00 to &D00 and represent characters 224 to 244. Most are dice numbers. Line 180 loads the second program.

In program 2, lines 10 to 20 set up various variables used in the program. U$ saves space

(continued on next page)

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later in the program where it is needed to plot the top and bottom of the dice. CHR$8 is the backspace cursor, CHR$10 takes the cursor down one line. In line 10 an array is set up which stores the co-ordinates of the corner of each square. It also tells the computer if there is a snake or ladder end on the square. Line 30 checks to see if a program has been played before. H% and J% are the scores. Line 60 prints up the title in a sine wave form — like a snake — and allows input of the names into Z$ and Y$. At line 70 the computer decides who is to go first. From 100 to 130 the screen display is built up and the array is filled with the appropriate co-ordinates. At line 140 heads and tails are put onto the ends of the snake body. Then, at 150 ladders are plotted and the game is started. The finale of the game is at lines 60 to 250. There are options to have another game. The data of all co-ordinates of all turning points on snakes, and ends of sides of each ladder are contained in lines 260-290. Line 300 is the procedures to draw the box — each section of the board, and line 310 is the procedure to draw snakes' heads and tails.

Climbing the ladder

Line 320 is the procedures to draw rungs on ladders. A mathematical approach was used here. The distance between two points X,Y and P,Q on a Cartesian co-ordinate system is given by

SQR (((x-p)squared) + ((y-q)squared))

Since we know the coordinates of the top and bottom of the sides of the ladder, we can now find out how many rungs there are on each ladder — if the distance between the rungs on all ladders is the same. We then plot a rung at the right points up each ladder. At 340 the game itself starts. A 1 is put into the array

A(4, ?)

The question mark represents the numbers of the squares which contain the bottom of a ladder or the top of a snake. At lines 390 to 530 the first player starts, throws his dice and makes his move. The second player's turn comes at lines 540 to 670. 690 to 740 contain the six routines for plotting the dice number — one for each possible roll of the dice. Line 750 is the procedure to actually go about plotting dice, making a rolling sound, and leaving a consecutively smaller gap between successive frames of the dice throw. Lines 800 to 890 actually move down a snake or up a ladder, if the question has been answered correctly. Line 900 contains the data for *For He's a Jolly Good Fellow,* and line 920 chooses a question.

Range of values

Lines 930 to 1010 put a question on the screen and check for an answer in a limited time. Line 1090 gives a range of values chosen by the computer for maths questions. The range is different for division, multiplication, addition, and subtraction.

For those of you who are just a bit lazy, and would like to take the easy way out, send a cheque or P.O. for £2.80 to the following address, and I will send you a copy of the program on a cassette, ready and working: Peter Donn, 33 Little Gaynes Lane, Upminster, Essex, RM14 2JR.

(listing continued from previous page)

```
  320DEFPROCLADDERS:GCOL0,4:READX,Y,X1,Y1,X2,Y2,X3,Y3:MOVEX,Y:DRAWX3,Y3:MOVEX1,Y
1:DRAWX2,Y2:LE=(SQR(((X3-X)^2)+((Y3-Y)^2)))/40:LEX=(X3-X)/LE:LEY=(Y3-Y)/LE:LEX1=
(X2-X1)/LE:LEY1=(Y2-Y1)/LE
  330N=X:M=Y:N1=X1:M1=Y1:FORJ=1TOLE:N=N+LEX:M=M+LEY:N1=N1+LEX1:M1=M1+LEY1:MOVEN,
M:DRAWN1,M1:NEXT:ENDPROC
  340DEFPROCGAME:FORA=1TO13:READSNH,SNT:A(3,SNH)=1:A(4,SNH)=SNT:NEXT:GCOL3,1:MOV
E0,80:PRINT"   WAIT PLEASE":COLOUR3:VDU4:PRINTTAB(1,2);A$;" STARTS":VDU5:GCOL0,3
  350MOVE1075,813:MOVE1175,813:PLOT85,1175,913:MOVE1075,913:PLOT85,1075,813:MOVE
1070,800:PRINTLEFT$(A$,2),TAB(18,12);H%:GCOL0,2:MOVE1075,113:MOVE1175,113:PLOT85
,1175,213:MOVE1075,213:PLOT85,1075,113
  360MOVE1070,255:PRINTLEFT$(B$,2),TAB(18,18);J%:COLOUR4:VDU4:X$="G A M E S  W O
 N":FORZ%=1TOLEN(X$):PRINTTAB(16,7+Z%);MID$(X$,Z%,1):NEXT:VDU5:GCOL3,3:MOVEA(1,1
),A(2,1):PRINTCHR$231:GCOL3,1:MOVEA(1,1)+46,A(2,1):PRINTCHR$231:POS1=1:POS2=1
  370MOVE16,512:PRINTa-48
  380IFPOS1<>1GCOL0,3:COLOUR3:PROCL(29):PROCL(2):VDU4:PRINTTAB(2,2);"TURN:";A$:V
DU5
  390PV=813:GCOL3,3:*FX15,1
  400PROCL(29):COLOUR3:VDU4:PRINTTAB(1,29);"KEY D TO THROW DICE":VDU5:GCOL3,2
  410D$=GET$:IFD$<>"D"THEN410
  420IFRN<>0PROCSUB(RN)
  430RN=RND(6):PROCDICE(RN):PROCL(29):COLOUR3:GCOL0,3:VDU4:PRINTTAB(1,29);"READY
 TO MOVE?":VDU5:GCOL3,3:*FX15,1
  440M$=GET$:IFM$<>"Y"THEN440
  450FORJM1=POS1 TOPOS1+RN:IFJM1>64 NEXT:ENDPROC
  460IFTR=1ORJM1=POS1 ORJM1=1 MOVEA(1,JM1),A(2,JM1):PRINTCHR$231
  470TR=0
  480IFJM1<>1MOVEA(1,JM1),A(2,JM1):PRINTCHR$231
  490FORZ=0TO999:NEXT
  500IFJM1<>1 ANDJM1<>POS1+RN MOVEA(1,JM1),A(2,JM1):PRINTCHR$231
  510IFJM1<>POS1+RN SOUND2,1,A(1,JM1)/4,1:SOUND3,1,A(2,JM1),1
  520NEXT:POS1=POS1+RN:IFA(3,POS1)=1PROCSNORL(0,POS1)
  530IFRN=6THEN380
  540PV=113:PROCL(29):PROCL(2):COLOUR2:VDU4:PRINTTAB(2,2);"TURN:";B$:VDU5:*FX15,
1
  550PROCL(29):COLOUR2:VDU4:PRINTTAB(1,29);"KEY D TO THROW DICE":VDU5:GCOL3,7
  560D$=GET$:IFD$<>"D"THEN560
  570IFRN2<>0PROCSUB(RN2)
  580RN2=RND(6):GCOL3,7:PROCDICE(RN2):GCOL0,2:PROCL(29):GCOL0,2:COLOUR2:VDU4:PRI
NTTAB(1,29);"READY TO MOVE?":VDU5:GCOL3,1:*FX15,1
  590M$=GET$:IFM$<>"Y"THEN590
  600FORJM2=POS2 TOPOS2+RN2:IFJM2>64 NEXT:ENDPROC
  610IFTR1=1 ORJM2=POS2 ORJM2=1 MOVEA(1,JM2)+46,A(2,JM2):PRINTCHR$231
  620TR1=0:IFJM2<>1 MOVEA(1,JM2)+46,A(2,JM2):PRINTCHR$231
  630FORZ=0TO999:NEXT
  640IFJM2<>1 ANDJM2<>POS2+RN2 MOVEA(1,JM2)+46,A(2,JM2):PRINTCHR$231:SOUND2,1,A(
1,JM2)/4,1:SOUND1,1,A(2,JM2),1
  650IFJM2<>POS2+RN2 SOUND2,1,A(1,JM2)/4,1:SOUND3,1,A(2,JM2),1
  660NEXT:POS2=POS2+RN2:IFA(3,POS2)=1PROCSNORL(46,POS2)
  670IFRN2=6THEN540
  680GOTO380
  690MOVE1096,77+PV:PRINTCHR$232+U$+CHR$233:RETURN
  700MOVE1097,78+PV:PRINTCHR$234+U$+CHR$235:RETURN
  710MOVE1097,80+PV:PRINTCHR$236+U$+CHR$237:RETURN
  720MOVE1098,80+PV:PRINTCHR$238+U$+CHR$239:RETURN
  730MOVE1098,80+PV:PRINTCHR$240+U$+CHR$241:RETURN
  740MOVE1098,80+PV:PRINTCHR$242+U$+CHR$243:RETURN
  750DEFPROCDICE(DI):SOUND1,0,60,1:INC=1:FORDTH=1 TO 1000:IFDTH<>1PROCSUB(RNTH)
  760INC=INC*1.5:DTH=DTH+INC:RNTH=RND(6):PROCSUB(RNTH):*FX15,5
  770SOUND0,-15,3,2:FORZ%=1TOINC*10:NEXT:NEXT
  780PROCSUB(RNTH):*FX15,5
  790SOUND0,-15,3,2:PROCSUB(DI):ENDPROC
  800DEFPROCSNORL(DIF,APOS):AR=A(4,APOS):AR1=APOS:IFA(2,AR1)<A(2,AR)DIR=4 ELSEDI
R=-4
  810PROCQ:IF(G%=0 ANDDIR=4)OR(G%=1 ANDDIR=-4)ENDPROC
  820MOVEA(1,APOS)+DIF,A(2,APOS)
  830FORD%=A(2,AR1)/4 TOA(2,AR)/4STEPDIR:SOUND1,-15,D%,1:SOUND3,-15,D%+32,1:NEXT
  840PRINTCHR$231:MOVEA(1,AR)+DIF,A(2,AR):PRINTCHR$231:IFPV=813 POS1=AR:TR=1 ELS
EPOS2=AR:TR1=1
  850ENDPROC
  860DEFPROCL(BAT):VDU4:PRINTTAB(0,BAT);SPC(20);:VDU5:ENDPROC
  870DEFPROCSUB(DT):ON DT GOSUB690,700,710,720,730,740:ENDPROC
  880DEFPROCSO2:*FX15,7
  890SOUND2,-12,C%,100:ENDPROC
  900DATA129,1,0,117,3,53,117,1,0,117,1,0,113,1,0,117,1,0,121,3,0,117,2,0,117,1,
0,109,3,33,109,1,0,109,1,0,101,1,0,109,1,0,117,3,53,101,2,0,109,1,0,117,3,0,117,
1,0,117,1,0,109,1,0,117,1,0,121,2,25,129,1,0,137,2,0,137,1,0,129,2,53
  910DATA121,1,0,117,2,33,109,1,0,101,4,53
  920DEFPROCQ:PROCL(2):PRINTTAB(4,2);"QUESTION":SOUND3,2,100,1:FORZ=0TO5000:NEXT
:A%=RND(4):ONA%GOSUB930,950,980,1000:ENDPROC
  930B%=RND(M%):L%=RND(M%):PROCL(29):PRINTTAB(5,29);B%;"+";L%;"=";:PROCANS:N%=B%
+L%:IFF%=N%G%=1ELSEG%=0
  940PROCREM:RETURN
  950B%=RND(I%):L%=RND(I%):IFL%>B%THEN950
  960PROCL(29):PRINTTAB(5,29);B%;"-";L%;"=";:PROCANS:N%=B%-L%:IFF%=N%G%=1ELSEG%=
0
  970PROCREM:RETURN
  980B%=RND(U%):L%=RND(U%):PROCL(29):PRINTTAB(5,29);B%;CHR$245;L%;"=";:PROCANS:N
%=B%*L%:IFF%=N%G%=1ELSEG%=0
  990PROCREM:RETURN
 1000B%=RND(R%):L%=RND(R%):PROCL(29):PRINTTAB(5,29);B%*L%;CHR$244;L%;"=";:PROCAN
S:N%=B%:IFF%=B%G%=1ELSEG%=0
 1010PROCREM:RETURN
 1020DEFPROCANS:C$="":E%=TIME:REPEAT:E$=INKEY$(0):IFASCE$<48ORASCE$>57THEN1040
 1030C$=C$+E$:PRINTE$;
 1040UNTILTIME>E%+800 OR E$=" ":F%=VAL(C$):ENDPROC
 1050DEFPROCREM:PROCL(29):VDU4:PRINTTAB(4,29);:IFG%=1PRINT"CORRECT":FORZ=-15TO0:
SOUND0,Z,1,2:NEXTELSEPRINT"WRONG: ITS ";N%:FORZ=-15TO0:SOUND0,Z,4,2:NEXT
 1060FORZ=0TO3000:NEXT:VDU5:ENDPROC
 1070DEFPROCSK:PRINTTAB(0,25);"Select level (1-6)"
 1080a=GET:IFa<49ORa>54THEN1080
 1090M%=INT((a-48)^3)*5:I%=INT((a-48)^3)*5-((a-48)^2):U%=INT(a-48)*5:R%=INT(((a-
48)*5)/2)
 1100ENDPROC
>
```

A two-minute operation turns your BBC Micro into the heart of a word processor.

VIEW is a software program from Acornsoft (the software division of Acorn Computers Ltd., who designed and built the BBC Micro) that enables you to use your BBC Micro, together with a printer, as a fully operational word processor.

View is supplied as a Rom chip that can easily be fitted to your BBC Micro by your local dealer, in a painless two-minute operation.

Then, once installed, you only have to switch on and View is operating immediately. (You can easily switch back to normal computing with a single command.)

Also included in the View package are two special books: 'Into View,' that takes you by easy stages through all the word processing commands and explains the many ways in which View can help you, and the 'View Guide,' which provides a quick reference to all View facilities.



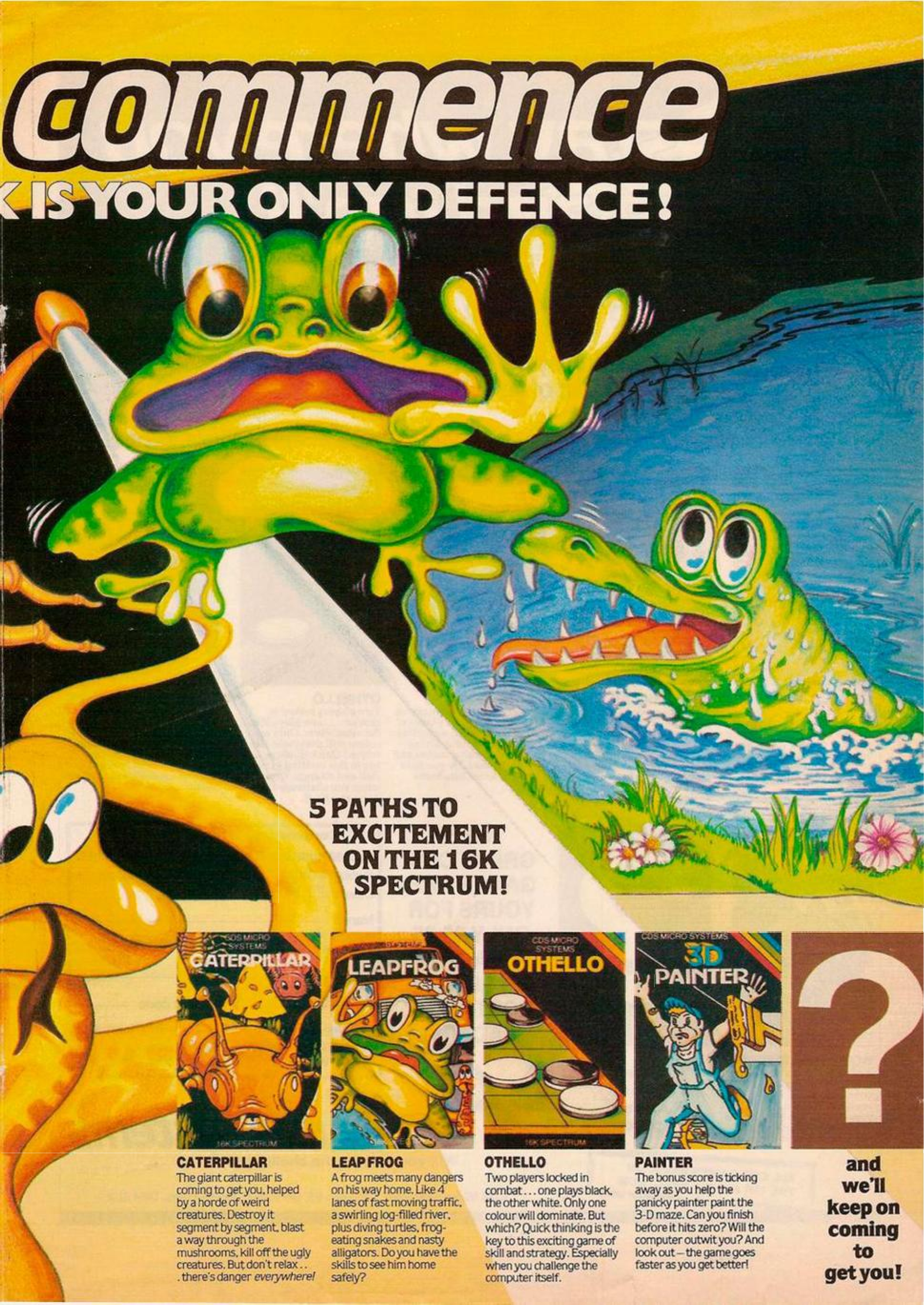
You'll find that View is, by any standards, a thoroughly professional system, yet still surprisingly simple for the beginner to master.

The 'Spark-Jet Printer' shown in the photograph is the ideal choice of printer for your word processing application. Extremely quiet, it offers high resolution graphics from monitor or T.V. screen and is available now from dealers.

If you'd like more information, write to Acornsoft, 4a Market Hill, Cambridge CB2 3NJ.

Or, for details of your local Acornsoft dealer, phone 01-200 0200.

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The giant caterpillar is coming to get you, helped by a horde of weird creatures. Destroy it segment by segment, blast a way through the mushrooms, kill off the ugly creatures. But don't relax . . . there's danger *everywhere!*
LEAP FROG
A frog meets many dangers on his way home. Like 4 lanes of fast moving traffic, a swirling log-filled river, plus diving turtles, frog-eating snakes and nasty alligators. Do you have the skills to see him home safely?
OTHELLO
Two players locked in combat . . . one plays black, the other white. Only one colour will dominate. But which? Quick thinking is the key to this exciting game of skill and strategy. Especially when you challenge the computer itself.
PAINTER
The bonus score is ticking away as you help the panicky painter paint the 3-D maze. Can you finish before it hits zero? Will the computer outwit you? And look out – the game goes faster as you get better!
and we'll keep on coming to get you!

ATOM PLOTTING POWER

The shape plotter.

```
   10REM
   20REM SHAPES FOR ACOR
N ATOM
   30REM BY S.YEWDALL
   40REM THIS PROGRAM MA
Y BE FREELY COPIED
   50REM PROVIDED A CRED
IT LINE IS INCLUDED
   60REM
   70DIM RR(31),VV(31),F
(10)
   80Z=#90;W=Z+8;D=W+6;S
=D+8
   90M=#2920
  100FOR I=0 TO 30;VV(I)
=M;RR(I)=M;N.
  110P.$21;GOSUB 150
  120P.$6
  130GOSUB 150
  140END
  150P=M;[
  160JMP VV20
  170JMP VV24
  180JMP VV27
  190JMP VV15
  200\(SET THE POINTERS(
  210\(SAVE A(
  220:RR0 STA Z
  230\(CLEAR MSB'S(
  240LDA @0;STA Z+1;STA
Z+3;STA Z+5;STA Z+7
  250\CALC A*4
  260LDA Z;CLC
  270ROLA;ROL Z+3;ROLA;R
OL Z+3
  280STA Z+2
  290\SET XP C=0 A=LSB
  300ADC #303;STA Z+6
  310LDA Z+3;ADC #31E;ST
A Z+7
  320\SET YP
  330CLC;LDA Z+2;ADC #30
4;STA Z+4
  340LDA Z+3;ADC #31F;ST
A Z+5
  350\SET AP
  360CLC;LDA Z+2;ADC #2E
C;STA Z+2
  370LDA Z+3;ADC #307;ST
A Z+3
  380\SET DP
  390LDY @1;LDA (Z+2),Y
  400\CALC D*8
  410CLC;ROLA;ROL Z+1;RO
LA;ROL Z+1;ROLA;ROL Z+1
  420ADC #2EF;STA Z
  430LDA Z+1;ADC #30A;ST
A Z+1
  440RTS
  450\(((
  460\SET SHAPE VALUES
  470\(((
  480\HERE FOR RUBOUT
  490\STAT1=BG
  500:RR1 LDY@0;LDA(Z+2)
,Y;AND @3;STA D+0
  510\STAT2=FG
  520LDA (Z+2),Y;AND @#C
4;STA D+1
  530LDA (Z+2),Y;LSRA;LS
RA;LSRA;AND @3;ORA D+1
  540JMP RR3 \(
  550\
  560\RTS WITH C=1 IF <>
 LIMITS
  570\LIMITS FFFFFF00-FF
  580\
  590\SET STAT1
  600:RR2 LDY @0;LDA (Z+
2),Y;LSRA;LSRA;LSRA;AND
@3;STA D+0
  610\SET STAT2
  620LDA (Z+2),Y;AND @#C
7
  630:RR3 STA D+1
  640\TEST MSB X CO-ORD
  650LDY @3;LDA (Z+6),Y;
STA W;BEQ RR4;CMP @#FF;B
NE RR6
  660\OK 00 OR FF
  670\TEST MSB Y CO-ORD
  680:RR4 LDA(Z+4),Y;STA
 W+1;BEQ RR5;CMP @#FF;BN
E RR6
  690\SET X & Y SIZE
  700:RR5 LDA (Z+2),Y;ST
A D+2;AND @#F;CLC;ADC @1
;STA D+3
  710LDA D+2;AND @#F0;LS
RA;LSRA;LSRA;LSRA;ADC @1
;STA D+2
  720\TEST SECOND DIGITS
  730DEY;LDA (Z+6),Y;CMP
 W;BNE RR6
  740LDA(Z+4),Y;CMP W+1;
BEQ RR7
  750:RR6 SEC;RTS
  760\OK ARE 00 OR FF
  770\TEST THIRD DIGITS
  780:RR7DEY;LDA (Z+6),Y
;CMP W;BNE RR6
  790\X CO-ORD OK STORE
 IT
  800:RR9 STA D+5
  810LDA (Z+4),Y;CMP W+1
;BNE RR6
  820\Y CO-ORD OK
  830:RR11 STA D+7
  840DEY;LDA (Z+6),Y;STA
 D+4
  850LDA (Z+4),Y;STA D+6
  860\ALL OK
  870CLC;RTS
  880\((
  890\PLOT ROUTINE
  900\((
  910\A=SHAPE
  920\SET POINTERS
  930:VV20 JSR RR0
  940\CHECK RANGE
  950JSR RR2;BCS VV21
  960\DRAW SHAPE
  970JSR VV0
  980\TEST FOR CHAIN
  990:VV21LDY @0;LDA (Z+
2),Y;AND @#20;BEQ VV22
 1000LDY @2;LDA (Z+2),Y;
JMP VV20
 1010:VV22 RTS
 1020\((
 1030\  THE UNPLOTER
 1040\((
 1050\SET POINTERS
 1060:VV24 JSR RR0
 1070\CHECK RANGE
 1080JSR RR1;BCS VV25
 1090\UNPLOT IT
 1100JSR VV0
 1110\CHECK FOR CHAIN
```

(listing continued on next page)

Stephen Yewdall's graphics aid harnesses the speed of machine code to drive your games with more style.

MANY ATOM owners have read with envy articles describing the latest computers and their graphic capabilities. Now help is at hand: whether you wish to produce text, graphics animation, or games, these routines will bring your Atom to life.

Written in machine code for use within Basic, these routines allow you to Plot, Unplot, and Move individual shapes or groups of shapes on the Atom's screen in any of the graphic modes. By using the Atom's Colour command you can draw shapes in different colours or shades. You can also generate noises while these shapes are being drawn.

Anyone familiar with Basic and the need to handle large groups of numbers will have used arrays. These routines were developed with this in mind. By modifying the array elements

(continued on next page)

(continued from previous page)

assigned for shapes and then Linking to one of the machine-code routines you can create your own shapes and produce your own style games.

The following arrays are used in the routines. The XX array holds the X position of each shape, the YY array holds the Y position of each shape, the AA array holds the attributes of each shape, and the DD array holds the pixel-blocks of each shape.

You can have up to 256 shapes, memory permitting. To have 256 shapes would require 5K of RAM, but in practice 10 to 20 would normally be sufficient. The number of shapes you require is declared in a dimension statement.

To declare one shape for program use, type

10 DIM DD(1), AA(0), XX(0), YY(0)

Note that in Atom Basic element 0 is valid. I have used the term pixel blocks to describe the pixels that make up what is drawn. If you look closely at any normal character on the Atom, you will see that it is made up of small dots or pixels. The prompt is a good example. If you were to draw it on graph paper it would look like figure 6.

You can see that it is made up of 35 pixels arranged as five by seven, which is standard format. The pixels are arranged in a block, hence the term pixel block. Figure 1 is an example of a typical alien pixel block, in this case it is shown as eight by eight, that is, 64 pixels. These shape routines are based on this eight by eight block format and this is assumed in future references to pixel blocks.

A closer look at the numbers beneath figure 1, reveals that the pixel block can be described in eight bytes, one byte for each row, each bit of each byte representing a single pixel. To store this information in memory we will need two elements of an array; this is because each element of an array occupies four bytes of memory. To store the pixel block of one shape, Dimension for two elements of array DD, as in the previous example.

By way of example, put figure 1 into pixel block 0:

30 DD(0) = #FF663C18; REM EVEN ELEMENT
32 DD(1) = #C38181C3; REM ODD ELEMENT

(listing continued from previous page)

```
 1120:VV25LDY @0;LDA (Z+
2),Y;AND @#20;BEQ VV26
 1130LDY @2;LDA (Z+2),Y;
JMP VV24
 1140:VV26 RTS
 1150\((
 1160\   THE BASIC MOVER
 1170\SAVE A
 1180:VV27 STA S+0
 1190\UNPLOT IT
 1200JSR VV24;LDA S+0
 1210\SET POINTERS
 1220:VV28JSR RR0
 1230\ADD X TO ARRAYX
 1240\LSB
 1250CLC;LDY@0;LDA(Z+6),
Y;ADC #339;STA (Z+6),Y
 1260\2ND
 1270INY;LDA (Z+6),Y;ADC
 #354;STA (Z+6),Y
 1280\3RD
 1290INY;LDA (Z+6),Y;ADC
 #36F;STA (Z+6),Y
 1300\4TH
 1310INY;LDA (Z+6),Y;ADC
 #38A;STA (Z+6),Y
 1320\ADD Y TO ARRAY Y
 1330CLC;LDY @0;LDA(Z+4)
,Y;ADC #33A;STA (Z+4),Y
 1340INY;LDA (Z+4),Y;ADC
 #355;STA (Z+4),Y
 1350INY;LDA (Z+4),Y;ADC
 #370;STA (Z+4),Y
 1360INY;LDA (Z+4),Y;ADC
 #38B;STA (Z+4),Y
 1370\CHECK RANGE
 1380LDA S+0;JSR RR2;BCS
 VV29
 1390\OK
 1400JSR VV0
 1410\CHECK CHAIN
 1420:VV29LDY@0;LDA(Z+2)
,Y;AND @#20;BEQ VV30
 1430\ANOTHER
 1440LDY @2;LDA (Z+2),Y;
STA S+0;JMP VV28
 1450:VV30 RTS
 1460\( THE SHAPE DRAWER
 1470\YCOUNT=8
 1480:VV0 LDA @8;STA W
 1490\SET Y CO-ORDS
 1500LDA D+6;STA #5C;LDA
D+7;STA #5D
 1510\YSIC=YSIZE
 1520:VV1 LDA D+3;STA W+
1
 1530\DASVE
 1540:VV2 LDY W;DEY;LDA
(Z),Y;STA W+4
 1550\XCOUNT
 1560LDA @8;STA W+2
 1570\X CO-ORDS
 1580LDA D+4;STA #5A;LDA
D+5;STA #5B
 1590\XSIC=XSIZE
 1600:VV3 LDA D+2;STA W+
3
 1610:VV4 LDA W+4;STA W+
5;ROL W+5;BCS VV5
 1620LDA D+1;AND @3;STA
#5E
 1630\TRANS.?
 1640BIT D+1;BMI VV9;BPL
 VV6
 1650\C-SET=FG
 1660:VV5 LDA D;AND @3;S
TA #5E
 1670\SNOW?
 1680:VV6 ;BIT D+1;BVC V
V8
 1690:VV7 BIT #B002;BMI
VV7
 1700\AT LAST PLOT IT
 1710:VV8 JSR VV14
 1720\INC X CO-ORDS
 1730:VV9 INC #5A;BNE VV
10;INC #5B
 1740\DEC. XSIC
 1750:VV10DEC W+3;BNE VV
4
 1760\ADJUST DSAVE
 1770ROL W+4
 1780\DEC XCOUNT
 1790DEC W+2;BNE VV3
 1800\SOUND?
 1810LDA D+1;AND @4;EOR
#B002;STA #B002
 1820\INC Y CO-ORDS
 1830INC #5C;BNE VV11;IN
C #5D
 1840\DEC. YSIC
 1850:VV11DEC W+1;BNE VV
2
 1860\DEC. YCOUNT
 1870DEC W;BNE VV1
 1880RTS
 1890\JMP TO PLOT
 1900:VV14 JMP (#3FE)
 1910\PLOT PIXEL-BLOCK
 1920\SET X CO-ORDS
 1930:VV15STX D+4;LDX @0
;STX D+5
 1940\SET Y CO-ORDS
 1950STY D+6;STX D+7
 1960\CLEAR MSB DP
 1970STX Z+1
 1980\SET STAT1
 1990INX;STX D
 2000\SET SIZE
 2010STX D+2;STX D+3
 2020\SET STAT2
 2030LDX @#C0;STX D+1
 2040\SET DP
 2050CLC;ROLA;ROL Z+1;RO
LA;ROL Z+1;ROLA;ROL Z+1
 2060ADC #2EF;STA Z
 2070LDA Z+1;ADC #30A;ST
A Z+1
 2080\NOW DO IT
 2090JMP VV0
 2100]
 2110R.
```

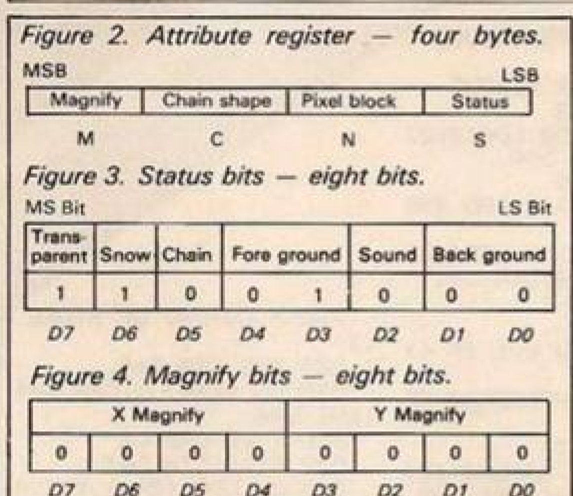


Figure 2. Attribute register — four bytes.

MSB			LSB
Magnify	Chain shape	Pixel block	Status
M	C	N	S

Figure 3. Status bits — eight bits.

MS Bit							LS Bit
Trans-parent	Snow	Chain	Fore ground		Sound	Back ground	
1	1	0	0	1	0	0	0
D7	D6	D5	D4	D3	D2	D1	D0

Figure 4. Magnify bits — eight bits.

X Magnify				Y Magnify			
0	0	0	0	0	0	0	0
D7	D6	D5	D4	D3	D2	D1	D0

Note that for each element the order of the bytes is reversed; this is to compensate for method of storage of Atom Basic which stores numbers with the bytes reversed.

What is a shape? A pixel block is not a shape, merely the collection of pixels that make up a shape when it is drawn. A shape has position and certain attributes that define how it is drawn.

The position of a shape on the screen is held in its XX and YY array elements; their values contain its position relative to the origin, which is the bottom left-hand corner of the screen. This origin is the same as used by the Atom's plot commands, normally labelled 0,0.

For example set the shape co-ordinates at origin

20 XX(0) = 0;YY(0) = 0

Note that the values of XX and YY describe the position of the bottom left-hand corner of the shape.

A shape has various attributes which are held in its attribute register, an element of array AA. The format of the attribute register is shown in figure 2. Each byte of the attribute register has a different function and, as there are four bytes in the register, there are four functions.

First, M — the most significant byte. The Mbyte is used by the machine-code routines to determine what size the shape will appear on the screen. In figure 4 the eight bits that make up the Mbyte are shown as they relate to X and Y magnification. If

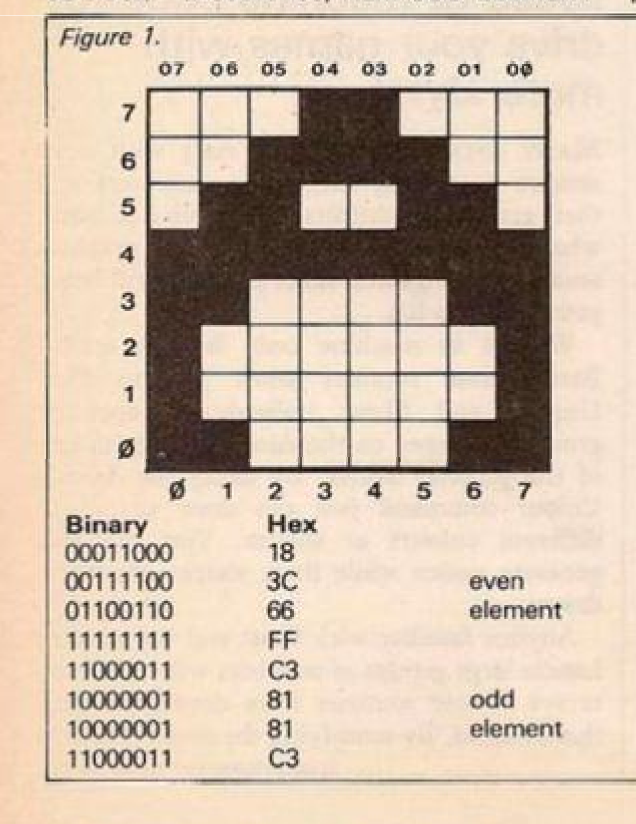
M = 0

then the shape is drawn without magnification, each pixel of its pixel block covering one pixel on the screen. If

M = #11

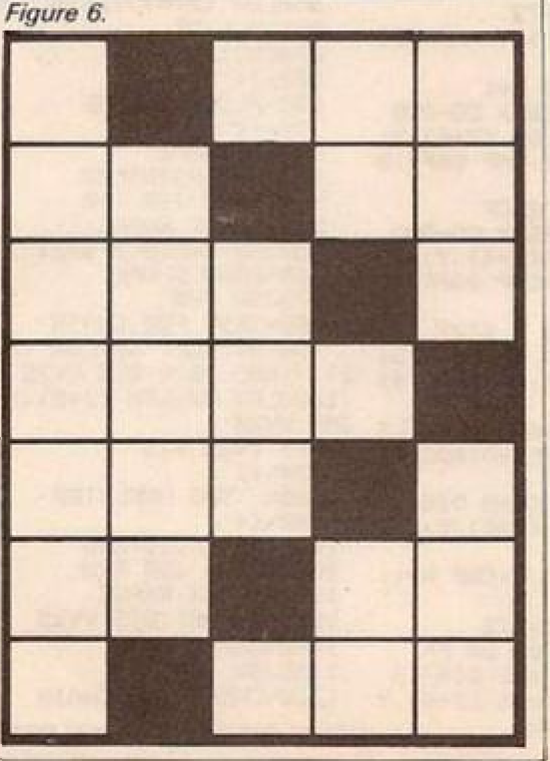
(continued on page 127)

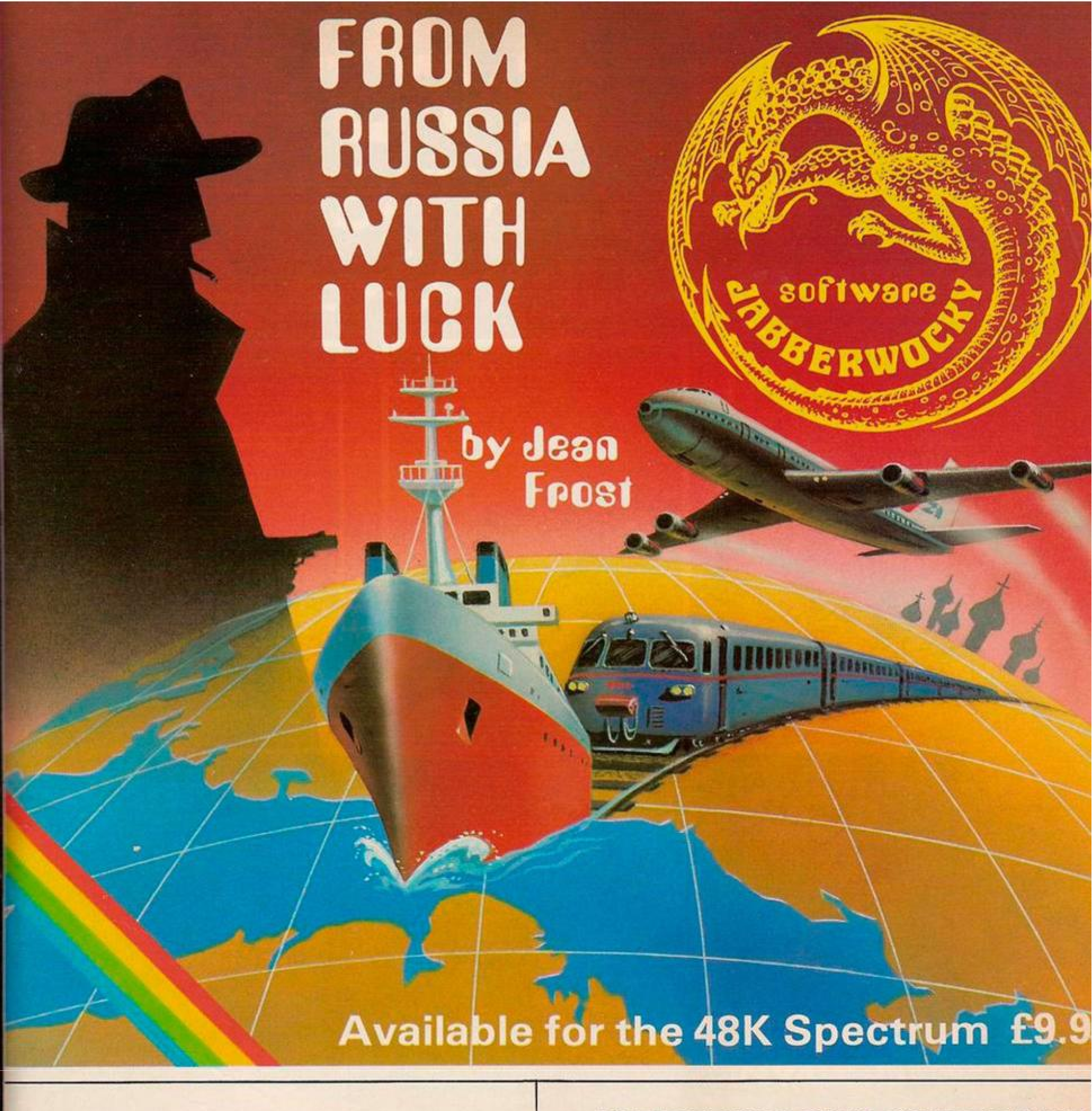
Figure 1.



Binary	Hex	
00011000	18	
00111100	3C	even
01100110	66	element
11111111	FF	
11000011	C3	
10000001	81	odd
10000001	81	element
11000011	C3	

Figure 6.




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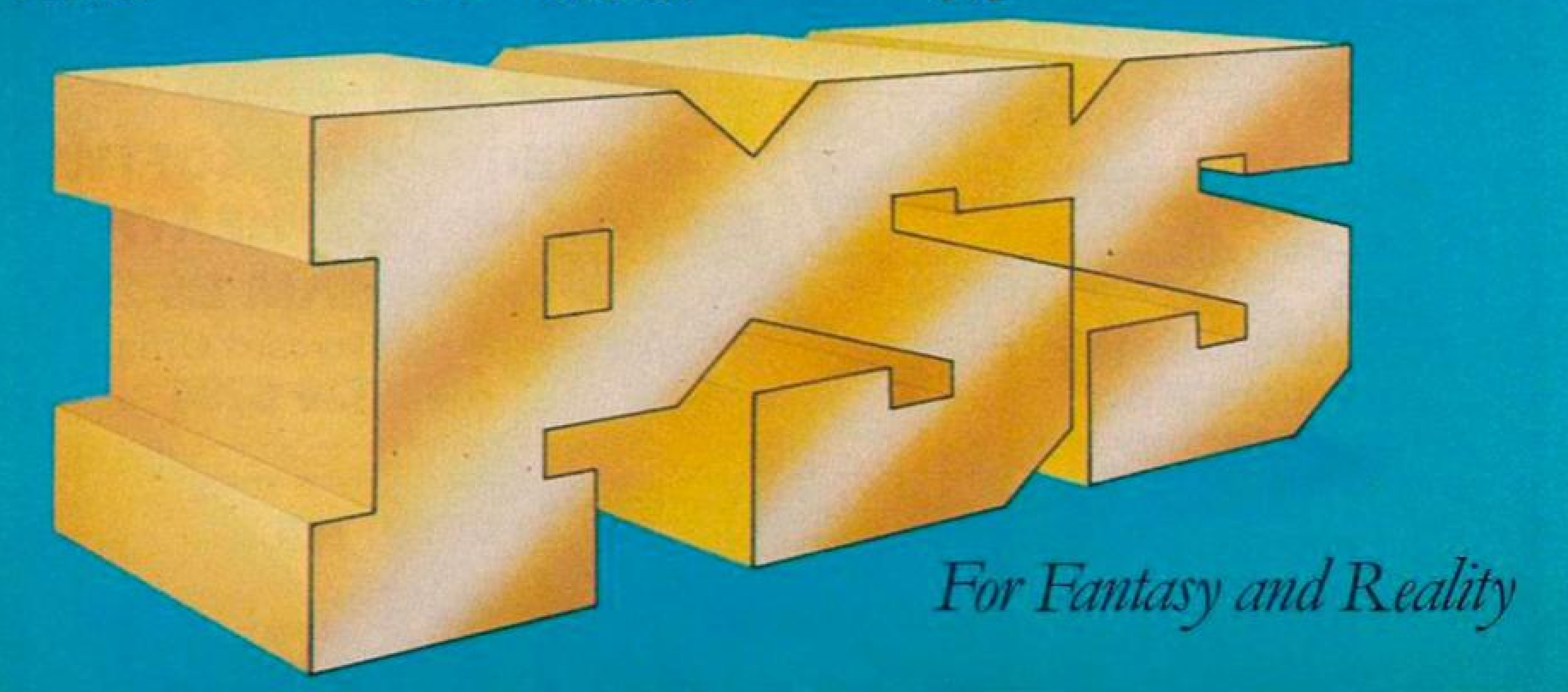
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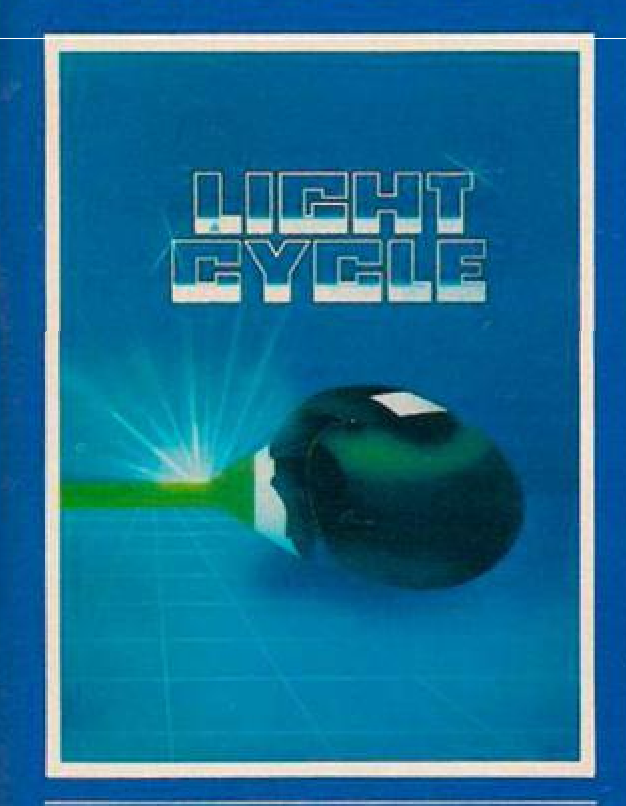
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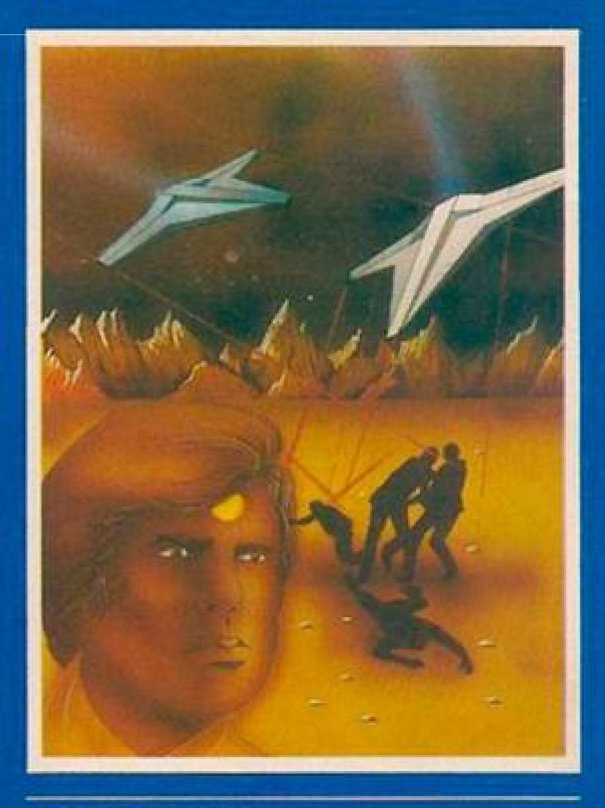
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(continued from page 122)
then the shape will be drawn twice size, each pixel of its pixel block covering four pixels on the screen. The shape can have a magnification factor of up to 15 either or both the X and Y directions. If

M = #F0

then the shape will be drawn normal height but 15 times as wide.

Secondly, C, the next byte, is used with the Chain bit of the status register to Chain shapes. If, say, shape 1 was Chained to shape 0 then whenever shape 1 was Plotted, Unplotted or Moved so too would shape 0. This is useful when you need to draw something with a pixel resolution greater than eight by eight, for example, for 16×8 two shapes Chained would be required. The value of C is the actual shape number that is Chained and can range from 0 to 255 — 0 to #FF. Third is N — the N byte is the number of the pixel block to be used when the shape is drawn. If N=0 then DD(0) and DD(1) will be used. Different shapes can have different or the same pixel blocks. The value of N can range from 0 to 255. Fourth is S — the least significant byte.

The status register is shown in expanded form by figure 3, the various bits having different functions.

Pixel bits that are not set in the pixel block 0 or unshaded in figure 1 can be transparent and will not be drawn with D7=1. Note that pixel bits that are set — binary 1 or shaded in figure 1 — are always drawn.

When data bit 6 is set to 1 screen drawing occurs only during flyback and hence will be interference free. Unfortunately this slows down the speed of drawing.

With data bit 5 equal to 1 followed by Chain the current operation is also applied to the shape given by C byte. Data bits 4 and 3 determine what the pixels that are set — binary 1 or shaded in figure 1 — in the pixel block do.

D4	D3	Function
0	0	Clear corresponding pixel on screen
0	1	Set corresponding pixel on screen
1	0	Invert corresponding pixel on screen
1	1	Clear corresponding pixel on screen

With data bit 2 — Sound = equal to 1, the Atom speaker part bit will be toggled — or changed — every time a pixel is drawn.

Data bits 1 and 0 determine what the pixels that are clear — binary 0 or unshaded squares in figure 1 — in the pixel block do:

D1	D0	Function
0	0	Clear corresponding pixel on screen
0	1	Set corresponding pixel on screen
1	0	Invert corresponding pixel on screen
1	1	Clear corresponding pixel on screen

Here is an example: set the shape attributes for normal size, pixel block 0, transparency, snow free, no Chain, no Sound, foreground set, background clear:

M=0, D=0, C=0, S= #C3 (Binary 11001000)

comes out as:

40 AA(0) = #000000C8

What can you do with shapes and pixel blocks? See figure 5. The address of each machine-code routine is given, together with what the Basic variables A, X and Y should contain. For the Plot-a-shape routine referred to at the top of figure 5, set arrays AA, DD, XX and YY as required. Put the shape number in Basic variable A then Link

Figure 5. Table of Link Addresses.

Operation	Address: Source	Address: Compiled	Variables: A	Variables: X	Variables: Y
Plot a shape	M+0	#2920	Shape number		
Unplot a shape	M+3	#2923	Shape number		
Move a shape	M+6	#2920	Shape number	X-direction	Y-direction
Plot a pixel block	M+1	#2929	Block number	X position	Y position

to #2920. For example, Plot a shape in mode 4.

5 Clear 4
50 A=0;LINK #2920

To Unplot a previously drawn shape it is important to remember that this can only be done provided it has the transparency bit set in its status register and the background bits are assigned clear. In graphic modes with only two colours the background bits may be assigned inverter clear. Put the shape number in Basic variable A then Link to #2923. So, to Unplot shape 0

55 A=0; LINK #2923

Now for the Move a shape routine. A previously-drawn shape may be moved — Unplotted then Plotted in a new position — provided its attributes comply with the previous example. The new position is relative to its old position by the contents of Basic variables X and Y. Put the shape number in variable A and the distances to be moved horizontally and vertically into variables X and Y respectively then Link #2926.

For example to Move shape 0 up 10 and right 20

70Y=10; X=20; A=0; LINK #2926

Note that X and Y can be positive or negative and XX and YY arrays will be updated to the new position.

For the first Plot a pixel block option, your pixel block will be plotted without magnification at the position contained in Basic variables X and Y. Put the pixel-block number in variable A, and the actual position horizontally and vertically into X and Y respectively, then Link to #2929. Thus to Plot pixel block 1 at 10, 10

90 X=10; Y=10; A=1; LINK #2929

Finally, the demonstration program draws shapes on the screen and moves them about, showing what can be achieved with the Shapes program.

Later it allows you to define your own shapes which can be manipulated on-screen using simple commands. ■

The demonstration program.

```
10DIM DD(19),AA(9),YY(9),XX(9),F(3)
20P.$30;CLEAR0
30P."demostration"
40P.'"YOU CAN DRAW A SHAPE"
50REM**SET PIXEL BLOCK**
60DD(0)=#AA55AA55;DD(1)=#AA55AA55
70REM**SET CO-ORDINATES
80XX(0)=10;YY(0)=10
90REM**SET ATTRIBUTES
100AA(0)=#C8
110REM DRAW IT
120A=0;LINK#2920
130GOS.820
140GOS.870;P."YOU CAN RUB IT OUT"
150A=0;LINK#2923
160GOS.820
170REM MOVE IT
180GOS.870;P."YOU CAN MOVE IT"
190REM RESET CO-ORDS
200XX(0)=0;YY(0)=0
210REM DRAW IT
220X=1;Y=1;A=0;LINK#2920
230REM NOW MOVE IT
240FOR I=0 TO 30
250LINK#2926
260NEXT I
270GOS.820
280REM MAGNIFY
290GOS.870;P."AND YOU CAN CHANGE THE SIZE"
300REM FIRST RUB OUT
310A=0;LINK #2923
320REM NOW DO IT
330AA(0)=#48;XX(0)=0;YY(0)=0
340FOR I=0 TO 4
350LINK#2920
360AA(0)=AA(0)+#11000000
370NEXT I
380GOS.820
390CLEAR0;GOS.870;P."AND YOU CAN CHAIN THEM"
400REM PIXEL INVADDERS
410DD(2)=#FF663C18;DD(3)=#C38181C3
420REM SET CO.ORDS
430FOR I=1 TO 5;YY(I)=0;XX(I)=I*10-10;N.I
440REM SET CHAINS
450AA(1)=#18C;AA(2)=#0101AC;AA(3)=#201AC;AA(4)=#301AC
460AA(5)=#401AC
470REM MOVE THEM
480X=0;Y=5;A=5;LINK#2920
490FOR I=0 TO 5
500LINK#2926
510NEXT I
520GOS.820
530REM NOW SHOOT THEM
540REMDEFINE TANK
550DD(4)=0;DD(5)=#7F3E1C08
560AA(6)=#2CC
570XX(6)=0;YY(6)=0
580REM SHOOT THEM
590A=6;LINK#2920
600Y=0;X=1
610FORI=0 TO XX(5)
620IF XX(6)=XX(1);GOS.840;A=1;LINK#2923
630A=6;LINK#2926
640IF XX(6)=XX(2);GOS.840;A=2;LINK#2923
650IF XX(6)=XX(3);GOS.840;A=3;LINK#2923
660IF XX(6)=XX(4);GOS.840;A=4;LINK#2923
670IF XX(6)=XX(5);GOS.840;A=5;LINK#2923
680N.I;GOS.820
690CLEAR0;GOS.870;P."NOW YOU TRY";GOS.820
700P.''"TYPE :"
710P.'"   P    TO PLOT"
720P.'"   R    TO RUBOUT"
730P.'"   M    TO MOVE"
740P.'"   C    TO CLEAR SCREEN"
750P.'"   A    TO CHANGE ARRAYS"
760P.'"PLUS RETURN"
770P.''"YOU HAVE 10 SHAPES BUT 0-6 ARE  ALREADY USED"
780P.''"PRESS A KEY TO CONTINUE";LINK#FE94
790CLEAR0
800G.900
810REM DELAY 3 SECS
820FORI=0 TO 100;WAIT;WAIT;NEXT I;R.
830REM PLOT LASER
840L=XX(6)+4;MOVE L,4;PLOT6 L,40;P.$7
850MOVE L,4;PLOT6 L,40;R.
860REM CLEAR TOP 3 LINES
870P.$30;FOR I=0 TO 63;I?#8000=32;N.I;R.
880GOS.870;IN."SHAPE NUMBER"S;IF S<0 OR S>10 G 880
890R.
900GOS.870;IN."YOUR COMMAND"$F
920IF $F="C";CLEAR 0;G.900
930IF $F="P";GOS.880;A=S;LINK#2920;G.900
940IF $F="R";GOS.880;A=S;LINK#2923;G.900
950IF $F="M"G.970
960G.1010
970GOS.880;A=S
980GOS.870;IN."X DIRECTION"X
990GOS.870;IN."Y DIRECTION"Y
1000LINK#2926;G.900
1010IF $F="A"G.1030
1020G.900
1030GOS.880
1040GOS.870;P."AA ,XX ,YY OR DD or EXIT"
1050INPUT $F
1060IF $F="E"G.900
1070IF $F="A";GOS.870;P."AA="&AA(S);IN.N;AA(S)=N;G.1040
1080IF $F="X";GOS.870;P."XX="&XX(S);IN.N;XX(S)=N;G.1040
1090IF $F="Y";GOS.870;P"YY="&YY(S);IN.N;YY(S)=N;G.1040
1100IF $F="D"G.1120
1110G.1040
1120GOS.870;P."EVEN ELEMENT"&DD(S*2);IN.N;DD(S*2)=N
1130GOS.870;P."ODD ELEMENT"&DD(S*2+1);IN.N;DD(S*2+1)=N
1140G.1040
```

ATARI

```
10 REM ************************
11 REM **    TIME TRIAL     **
20 REM **  BY STAN OCKERS   **
30 REM ************************
40 REM ** ALL REMS CAN BE DELETED **
100 DIM M$(32),S$(8),P$(8),T(5):OPEN #1,4,0,"K:"
150 REM ** NEW CHARACTER SET **
155 REM ** ML routine for moving 1K **
160 FOR I=1 TO 32:READ A:M$(I)=CHR$(A):NEXT I
170 DATA 104,104,133,204,104,133,203,104,133,206,104,133,205,162,4,160,0,177,203,145,205,136,208
,249,230,204
175 DATA 230,206,202,208,240,96
177 REM ** Lower RAMTOP and move character set **
180 POKE 106,PEEK(106)-5:GRAPHICS 0:CS=(PEEK(106)+1)*256:A=USR(ADR(M$),57344,CS)
185 REM ** Change a couple of characters ($ and %) **
190 FOR I=CS+32 TO CS+47:READ A:POKE I,A:NEXT I
195 DATA 36,109,73,146,146,73,109,36,36,182,146,73,73,146,182,36
200 REM ** NEW DISPLAY LIST **
210 GRAPHICS 18:DL=PEEK(560)+256*PEEK(561):A=PEEK(DL+4)+256*PEEK(DL+5):A=A+22:B=INT(A/256):C=A-B
*256
220 POKE DL+4,C:POKE 88,C:POKE DL+5,B:POKE 89,B:POKE DL+6,6:POKE DL+7,6
230 FOR I=17 TO 19:POKE DL+I+21,PEEK(DL+I):NEXT I
240 FOR I=DL+8 TO DL+35 STEP 3:POKE I,103:POKE I+1,146:POKE I+2,6:NEXT I:POKE DL+35,71
245 POKE 756,CS/256:POKE 708,200:POSITION 4,0:? #6;"INITIALIZING"
250 REM ** DATA FOR ROADWAY **
252 REM ** Try making your own **
255 RESTORE 265
260 RW=(PEEK(106)-10)*256:FOR I=RW TO RW+512:READ A:A=A+141:POKE I,A:NEXT I
265 DATA 25,5,5,5,5,5,5,5,5,5,4,4,4,4,3,3,3,3,2,2,2,2,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0
267 DATA 1,1,1,1,1,1,1,2,2,2,2,2,2,3,3,3,3,3,3,4,4,4,4,4,4,5,5,5,5,5,5,6,6,6,6,6,6,7,7,7,7,7,7,7
,7,8,8,8,8
270 DATA 8,8,8,8,9,9,9,9,10,10,10,10,9,9,9,9,8,7,6,5,4,3,2,1,0,1,2,3,4,5,6,7,8,9,9,9,9,8,8,8,7,7
,7,6,6,6,5
275 DATA 5,6,6,7,7,8,8,9,9,8,8,8,8,8,7,7,7,7,7,6,6,6,6,6,5,5,5,5,4,4,4,4,3,3,2,2,1,1,0,0,1,1,2,2
,3,3,4,4,5
277 DATA 5,6,6,7,7,8,8,9,9,8,7,6,5,4,3,2,1,0,0,0,1,2,3,4,5,6,7,8,9,9,9,9,9,9,9,8,7,6,5,4,3,2,1,1
,1,0,0,0,0
280 DATA 0,0,0,0,0,0,0,0,0,1,1,1,2,2,2,3,3,3,4,4,4,5,5,5,6,6,6,7,7,7,8,8,8,9,9,9,9,9,9,9,9,9,9
,9,9,9,9,9
282 DATA 8,8,8,7,7,7,6,6,5,5,4,4,3,3,2,2,1,2,1,1,2,2,1,1,1,3,3,3,4,5,6,7,8,9,8,7,6,5,4,3,2,1,1,1
,1,1,1,1,1
285 DATA 2,2,2,2,3,3,3,3,4,4,4,4,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,6,6,6,6,6,7,7,7,7,7,7,8,8,8,8
,7,7,6,6,5
287 DATA 5,5,5,6,6,6,7,8,9,8,7,6,5,5,5,5,5,4,3,2,1,1,1,2,3,4,5,6,7,8,9,9,8,7,6,5,4,3,2,1,2,3,4,5
,6,7,8,9,8
288 DATA 7,7,6,6,5,5,4,4,3,3,2,2,1,1,2,2,3,3,3,4,4,4,5,5,5,6,6,7,7,8,8,9,9,8,8,8,8,7,7,7,6,6,6,5
,5,5,5,5,5
290 DATA 5,5,5,4,3,2,1,2,3,4,5,5,5,5,5,5,5,5,5,5,5,5,5,5,114
300 REM ** PAGE SIX POKES **
310 RESTORE 315:FOR I=1536 TO 1731:READ A:POKE I,A:NEXT I
314 REM ** Change VBI vector **
315 DATA 104,160,17,162,6,169,7,76,92,228
316 REM ** Init. data for VBI routine **
317 DATA 1,1,0,0,0,0,0
318 REM ** VERT BLANK ROUTINE ** Determine scroll value **
319 DATA 206,11,6,208,94,173,10,6,141,11,6
320 DATA 173,12,6,206,16,6,74,176,250,173,16,6,141,5,212,16,71
321 REM ** Move lines down **
322 DATA 169,16,141,16,6,173,48,2,133,203
325 DATA 56,233,3,133,205,173,49,2,133,204,133,206,160,37,177,205,145,203,136,177,205,145,203,13
6,136
330 DATA 192,10,208,241
331 REM ** Add a new line **
332 DATA 230,207,208,2,230,208,162,0,161,207,201,255,208,15,173,14,6,133,207
333 DATA 173,15,6,133,208,161,207,238,13,6,136,145,203
335 DATA 173,0,211,72,41,8,208,2,230,209,104,41,4,208,2,198,209,165,209,141,0,208,76,98,228
338 REM ** Screen roadway data **
340 DATA 4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5,4,5
,4
342 REM ** Remove our VBI routine **
343 DATA 104,160,98,162,228,169,7,76,92,228
344 REM ** POS. AT BEG. OF RW DATA **
345 POKE 1550,0:POKE 1551,RW/256:POKE 207,0:POKE 208,RW/256
350 REM ** ROADWAY WIDTH **
358 POSITION 0,0:? #6;"                    "
360 POSITION 0,1:? #6;"ROAD WIDTH (1)NARROW TO (3) WIDE        ":GET #1,A:W=A-48:IF W<1 OR W>3 T
HEN 360
370 FOR I=1690-W TO 1693+W:POKE I,0:NEXT I:FOR I=1710-W TO 1713+W:POKE I,222:NEXT I
400 REM ** PM GRAPHICS **
410 A=PEEK(106)-7:POKE 54279,A:PM=256*A:POKE 559,46:POKE 53277,3:X=120:POKE 53248,X:POKE 209,X:P
OKE 53256,1
415 RESTORE 430
420 FOR I=PM+512 TO PM+640:POKE I,0:NEXT I:POKE 704,56:Y=90:FOR I=PM+512+Y TO PM+528+Y:READ A:PO
KE I,A:NEXT I
430 DATA 153,153,255,153,153,24,24,60,36,36,36,36,165,165,231,189,153
440 FOR I=1 TO 8:READ A:P$(I,I)=CHR$(A):NEXT I
450 DATA 106,96,85,76,63,51,40,22
490 POSITION 0,1:? #6;"PRESS FIRE BUTTON   WHEN READY TO START"
492 IF STRIG(0)=1 THEN 492
495 A=USR(1536)
500 REM
502 POSITION 0,1:? #6;"TOTAL        LAP   ":POSITION 0,2:? #6;" AVG. SPEED AVG. LAP"
504 REM ** RESET CLOCK - INIT. VAR. **
505 Z=0:POKE 18,Z:POKE 19,Z:POKE 20,Z:LAP=0:T(0)=0:DIST=220000:DIS=12
507 REM ** SPEED BYTES STRING **
510 RESTORE 520:FOR I=1 TO 8:READ A:S$(I)=CHR$(A):NEXT I:N=1:TT=30
520 DATA 0,1,3,7,15,31,63,127
522 REM ** CK TRIGGER - CLEAR COLL. REG. **
525 T=STRIG(0):POKE 53278,0
530 REM ** TT IS ACCELERATOR RESPONSE COUNTER **
531 TT=TT-1:IF TT>0 THEN 560
532 TT=30
533 IF T=1 AND N=1 THEN 560
536 IF T=0 AND N=8 THEN 560
540 IF T=1 THEN N=N-1:IF N=0 THEN N=8
```

NOTES
LINE 358 CONTAINS 20 BLANK SPACES
END OF LINE 620 HAS 11 BLANKS
END OF LINE 640 HAS 9 BLANKS

```
550 IF T=0 THEN N=N+1:IF N=9 THEN N=1
555 REM ** SET SPEED **
560 POKE 1548,ASC(S$(N,N))
570 L=PEEK(1549):IF L>LAP THEN GOSUB 2010
572 IF L=5 THEN 610
573 REM ** COLLISION DETECTION **
575 IF PEEK(53252)=1 THEN GOSUB 1010
577 REM ** PRINT SPEED - MOTOR SOUND **
580 POSITION 7,0:? #6;20*N;" "
582 IF DIS=12 THEN DIS=2:GOTO 584
583 IF DIS=2 THEN DIS=12
584 SOUND 0,ASC(P$(N,N)),DIS,7+N
590 GOTO 525
600 REM ** FINISH ROUTINE **
610 SOUND 0,0,0,0:A=USR(1722)
620 POSITION 0,0:? #6;"AVG. = ";INT(TS);"
630 IF TS>RA THEN RA=TS
640 POSITION 0,1:? #6;"RECORD = ";INT(RA);"
650 POSITION 0,2:? #6;"Again? Press Trigger"
655 IF STRIG(0)=0 THEN 655
660 IF STRIG(0)=1 THEN 660
670 GOTO 310
1000 REM ** COLLISION SUBROUTINE **
1010 FOR I=0 TO 3:SOUND I,50+20*I,2*I+2,
     12:NEXT I
1020 FOR I=N TO 1 STEP -1
1030 N=I:POKE 1548,ASC(S$(N,N)):POKE 712,
     N*16+8:POKE 704,N*16+10:FOR J=1 TO
     10:NEXT J:NEXT I
1090 POKE 704,56:POKE 712,0:FOR I=0 TO 3:SOUND
     I,0,0,0:NEXT I:RETURN
2000 REM ** NEW LAP SUBROUTINE **
2005 REM ** Ck. clock for lap time - calc.
     speed **
2010 LAP=L:T(LAP)=PEEK(20)+256*PEEK(19)+256*
     256*PEEK(18):SP=DIST/(T(LAP)-T(LAP-1))
2020 POSITION 12,0:? #6;INT(SP);"   ":TS=DIST
     *LAP/(T(LAP)-T(0)):POSITION 1,0:?
     #6;INT(TS);" "
2025 POSITION 18,0:? #6;LAP
2030 RETURN
```

CS = display list
DL = display list
RW = road way
VBI = vertical blank interrupt
W = width of road
T = trigger fire button
TT = trigger total — accelerator

TIME TRIAL is a machine-language program: it moves the road while a Basic program creates sounds and checks collisions. The machine-language program runs during the time that the electron beam in the TV tube is returning from bottom to the top of the screen, which is referred to as the "vertical blank" period.

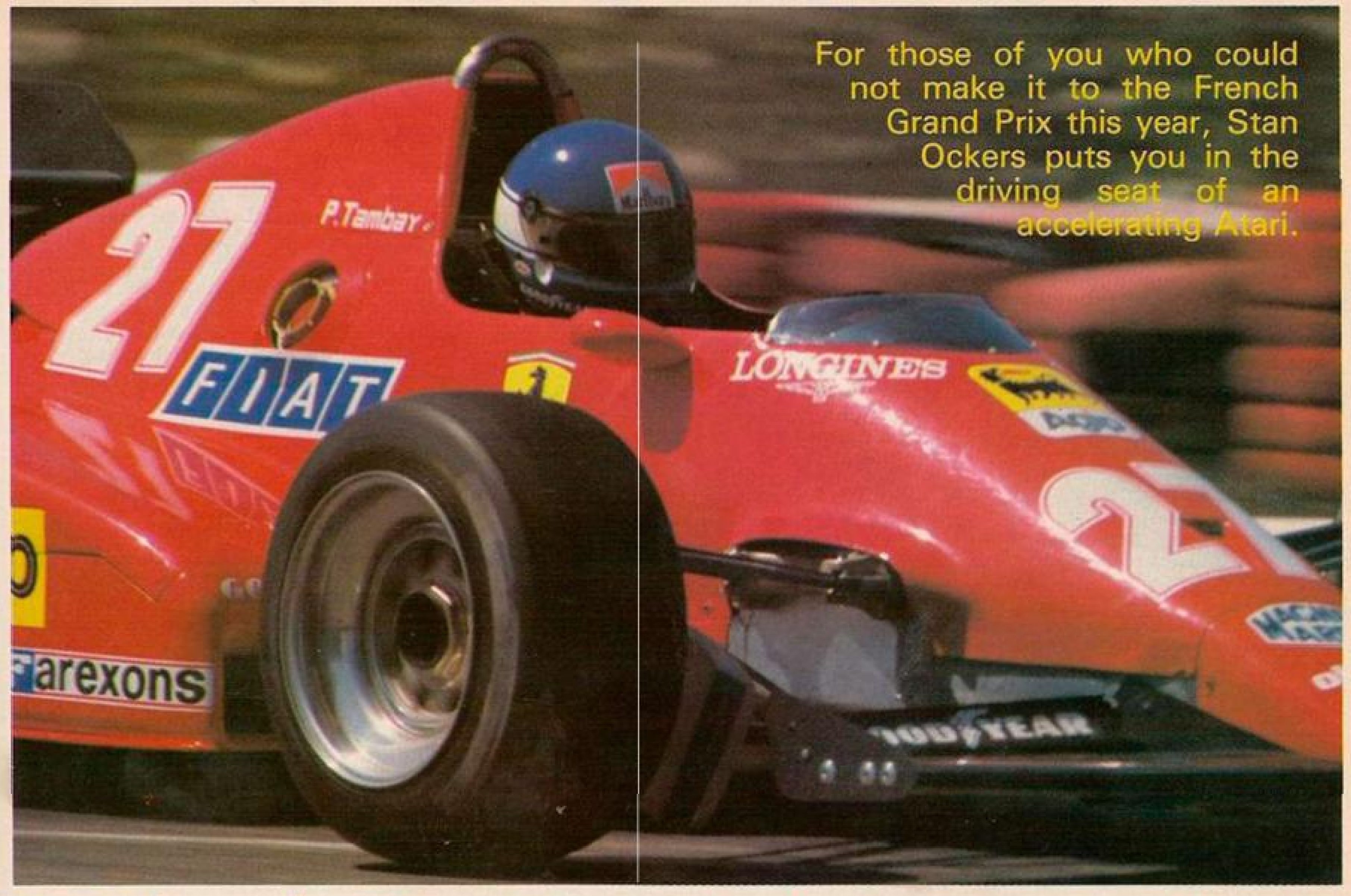
Basic is normally interrupted during this time for the operating system to do certain updating chores. There is also plenty of time for our scrolling program. Because the screen is blanked at this time the updating will not cause flickering.

The key to scrolling is the display list and in particular the LMS instruction — Load Memory Scan. The display list is a set of instructions for Antic, the microprocessor which controls the screen. The display list for GR 18 is given in table 1. The LMS instructions point to the area in memory where screen data resides. The instructions following are single byte because they just continue picking up data where the last line left off.

The revised display list appears in table 2. Each line of characters in the scrolled region has its own LMS instruction. This allows using portions of the same data for many lines — the starting position is displaced. A display list similar to table 1 with scrolling activated could be used, but the data would have to be a continuous chunk of memory. Thus 512 roadway lines would require

$$512 \times 20 = 10{,}240$$

bytes of data. A lot more variation and detail would be available but that is a lot of memory.



TIME TRIAL RUN

In lines 150-195 a new character set is constructed to get just two new characters. The whole character set is moved down into RAM. Doing this in Basic takes over 20 seconds so here a machine-language routine stored in M$ does it. Calling is by

A=USR(ADR(M$), ADDR1, ADDR2)

for moving 1K from Addr1 to Addr2. The machine-language routine takes less than a couple of seconds. RAMtop is moved down five pages to make room for the character set. Basic thinks RAM stops five pages lower. The extra page is because Basic will actually alter a few bytes beyond RAMtop if they exist — normally they do not.

After creating the new display list and Poking in data for the roadway, the vertical blank routine is Poked into page 6. The routine communicates with Basic through a set of locations listed in table 3. The routine does a number of things. The number indicating how much of a character is scrolled changes from 16 down to 0. It is then reset to 16, each LMS pointer is shifted down into the next LMS pointer — moving all lines down screen, and the LMS pointer for the top line is set by referring to the next roadway data byte.

If the byte is 255, the pointer is set by returning back to the beginning of the roadway data. Notice that is necessary to use machine language to insert or remove our VBI routine. In Basic an interrupt could occur between changing the low and high bytes of the pointer resulting in a disastrous jump. The OS provides a routine at &E45C to solve this problem.

How rapidly scrolling takes place would normally be determined by the byte at 1546 — Count — which resets a counter — CNTDN — at 1547. This turned out to be much too slow so a one was placed in Count and some scrolling takes place every time through. To go even faster, some positions between 16 and 0 are skipped. The number of positions skipped is found by shifting the byte at 1548 right until a 0 bit is found. The number in 1548 then controls the speed — Poked in at line 560 in the Basic program.

The car is a PM graphics player set up in lines 400-430. The seven additional pages down from RAMtop put the start of PM area on a 1K boundary as it must be. Even though horizontal movement requires only a Poke of one location, it proved to be slow and jerky in Basic. The solution was to put this function into the vertical blank routine where it is updated every 0.016 seconds.

The point of the program is to move the car around the track of five laps as fast as possible. The fire button — joystick player 1 — is the accelerator, down to speed up, and up to slow down. Going off track will slow you down.

Table 1. Original display list.

DL+	Entry	Purpose
0-2	112'S	Blank lines
3-5	71 xx xx	LMS to point to display data
6-16	7's	11 more lines, 16 scan lines wide
17-19	65 yy yy	JMP to DL after wait for VB

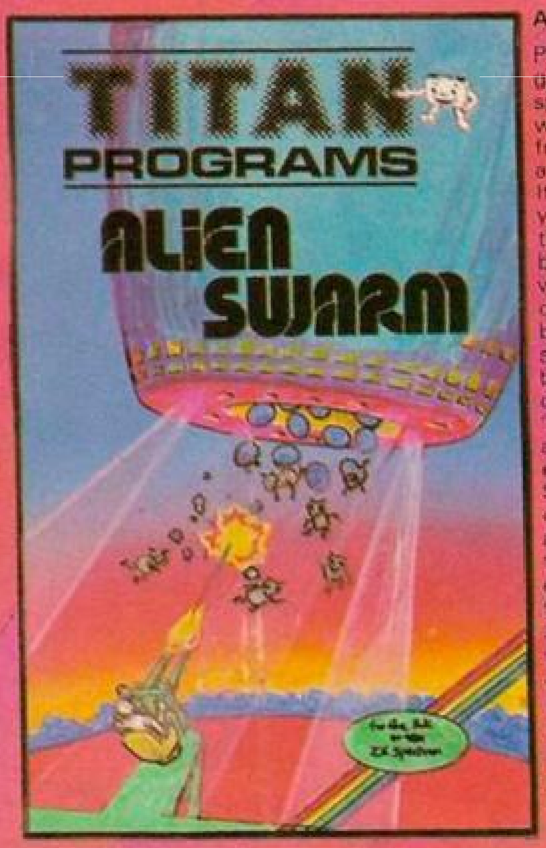
Table 2. Revised display list

DL+	Entry	Purpose
0-2	112's	Blank lines
3-5	71 zz zz	LMS pointer moved up 21 bytes
6-7	6's	2 lines 8 scan lines wide
8-10	103 aa aa	LMS points to data in page 6 (9 sets total)
32-34	103 aa aa	
35-37	71 aa aa	LMS as before but without Vscroll
38-40	65 yy yy	JMP to DL after wait

Table 3.

1546	060A	Count
47	060B	CNTDN
1548	060C	Skip Char, lines skipped
1549	060D	Times Lap counter
1550	060E	Low, Low-byte roadway pointer
551	060F	High High-byte roadway pointer
1552	0610	VShadow copy of VScroll

From Another Galaxy com

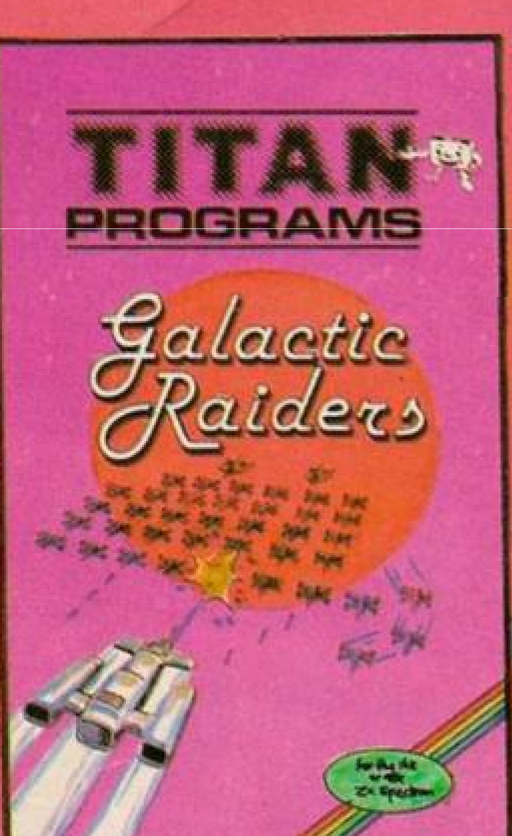


ALIEN SWARM £5.95

Probably the most addictive game yet for the 16K or 48K spectrum. Can you survive three waves of hypnotic, brain jerking frenzy as the Aliens set on you in a merciless battle of untold fear? If you reach the third wave will you be skilled enough to outwit the SWARMERS? These sit behind force fields laying eggs which hatch into the most deadly of weapons. These become homing bombs which seek you out. High energy bombs which explode to form a deadly shrapnel fallout and the "dreaded eyes" which hover above you and unleash a bolt of energy which travels at Superhuman speed. Squadrons of SWARMERS attack in turn and each Squadron is faster than the last. You have to be quick and agile to save Earth from these, the most evil of Aliens.

When you are eventually overwhelmed how many of the SWARM will you have destroyed?

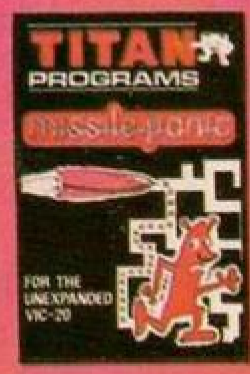
Features: Fast action — Sound effects — full use of colour — Hi-Score (Plus full name feature)



GALACTIC RAIDERS £4.95

I'm trapped in a brain tearing Supanova. They're everywhere; screaming, swooping, twisting my nerves into oblivion. Every ounce of energy, every last gasping breath must be thrust into my final attack. My lazer base is all but destroyed, I can't go on, this is blowing my mind!

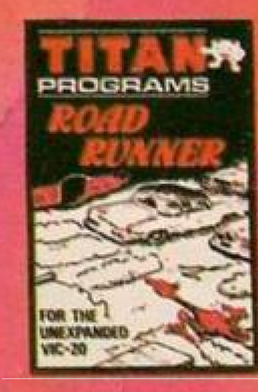
The Raiders are here . . . a heart stomping game for spectrum owners everywhere. Play it if you dare!



MISSILE PANIC £6.00

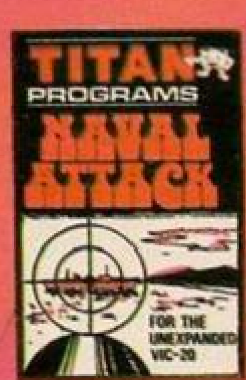
Never in the world of computer games has such a game been produced for such a machine. The panic starts when you take delivery. First the panic to unpack, then the panic in play.

You will capture Crossoids and will have to stay clear of the missiles venomous path in the 'Maze of Death'. See it to believe it!!



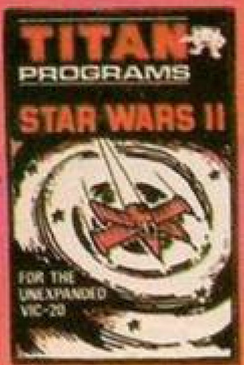
ROAD RUNNER £5.00

In this remarkable game you must control Eric, the Road Runner, through the "space warp of vehicle molecular", and safely into the gravity space lanes. With ever-increasing levels of play, a super-cool head is needed to conquer this addictive machine code game. For arcade enthusiasts everywhere.



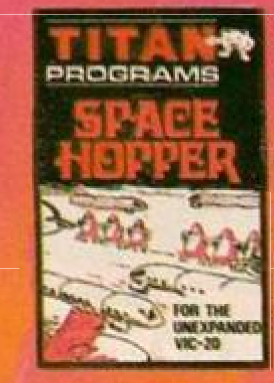
NAVAL ATTACK £5.00

With stunning Graphic display of mountains, golden beaches and deep blue seas, you are assigned to attack a vehicle convoy. Your on board gun has a quite unique sight which allows you to destroy your target with incredible precision. A totally addictive game that will leave you trembling with excitement.



STAR WARS II £5.00

Only the Force can save you!!! In this perilous journey through time and space, having conquered the evil empire, you must now follow Luke's steps and destroy as many of Xatar's ships as possible. Your arms are limited and with a short supply of fuel, time is of the essence, only the fit can survive; that is if the Force of Titan is with you!



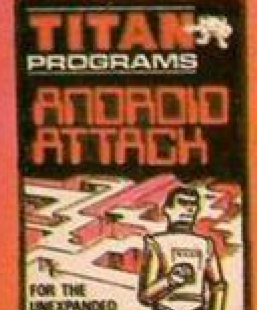
SPACE HOPPER £5.00

Once there was Invaders, then Packmen, now there's Space Hopper. Can you guide your Space Frog through the hustle and bustle of space traffic without being crushed by intergalactic space trains? Can you avoid being shot by hidden laser guns and are you able to hop through the space warp. If you think you can order it today!



SPACE WARS/ BATTLE ZONE £5.00

Two very exciting, hi-resolution, fast action, two player games that can be played simultaneously; for the price of one. Space wars (like the arcade game) is a typical dog fight. In Battle Zone, a cool, tactical head is needed to outwit your opponent.



ANDROID ATTACK £5.00

The Androids of Jupiter (an ever growing race) are on your path in the maze of the lost Isle. They look more menacing as each second passes and will attack without mercy. Run to stay alive.

VIC-20 GAMES
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```
10 POKE5992,23:POKE5993,111
20 GOSUB2000
100 Q$=INKEY$:IFQ$<>""THENCLS
105 IFQ$="S"THENGOSUB1600
110 IFQ$="I"THENGOSUB1400
120 IFQ$="D"THENGOSUB1200
130 IFQ$="T"THENGOSUB1000
140 IFQ$="P"THENGOSUB600
150 IFQ$="C"THENGOSUB200
160 IFQ$="O"THENGOSUB800
170 IFQ$="M"THENGOSUB1800
180 IFQ$="H"THENGOSUB2000
190 IFQ$="W"THENGOSUB2200
195 IFQ$="Z"THENGOSUB2600
199 GOTO100
200 INPUT"CERTAIN (Y)";A$
210 IF A$="Y" THEN EXEC5966
220 RETURN
400 H=JOYSTK(0):V=JOYSTK(1)
410 H=H/2:V=INT(V/4)
420 CU=(1024+32*V+H):POKECU,159
430 CA=6000+(SC-1)*512+CU-1024
440 POKE5990,INT(CA/256):POKE5991,CH-(PEEK(5990)*256)
445 GOSUB1610
447 LI=256*PEEK(5992)+PEEK(5993)
450 IF INKEY$="R" THEN RETURN ELSE GOTO 400
600 INPUT"START PRINTING AT BEGINNING OF  SCREEN NO.:";N
605 N=6000+512*(N-1)
610 POKE5982,INT(N/256):POKE5983,N-(PEEK(5982)*256)
620 INPUT"NUMBER OF SCREENS I SHOULD PRINT:";N
630 POKE5984,N*2:POKE5985,0
640 EXEC5657
650 RETURN
800 FR=1:PRINT"OVERWRITE":GOSUB1000
810 GOSUB1600:GOSUB400:IF CA>=LI THENGOSUB2400:RETURN
820 EXEC5941
830 FR=0:A$="":RETURN
1000 A$="":LINE INPUT "TEXT:";A$
1005 IF A$="" THEN 1000
1010 L=LEN(A$):IF L>160 THEN PRINT:PRINT"TOO LONG":RETURN
1020 A=VARPTR(A$)+2:B=VARPTR(A$)+3
1030 POKE5986,PEEK(A):POKE5987,PEEK(B):POKE5998,0:POKE5999,L
1035 IF FR=1 THEN RETURN
1040 EXEC5736
1050 RETURN
1200 INPUT"NUMBER TO DELETE";N:IFN=0 THEN N=1
1205 GOSUB1600
1210 POKE5998,INT(N/256):POKE5999,N-(PEEK(5998)*256)
1220 GOSUB400
1225 IF CA>=LI THEN GOSUB2400:RETURN
1226 IF N>=(CA-6000) THEN GOSUB2400:RETURN
1230 EXEC5837
1240 RETURN
1400 FR=1:PRINT"INSERT":GOSUB1000
1410 GOSUB1600:GOSUB400:IF LI<=CA THEN GOSUB2400:RETURN
1420 EXEC5772
1430 POKE5998,0:POKE5999,L:EXEC5941
1440 FR=0:A$="":RETURN
1600 INPUT"SCREEN:";SC:IFSC=0 THEN SC=1
1610 SP=6000+(SC-1)*512:POKE5988,INT(SP/256):POKE5989,SP-(PEEK(5988)*256)
1620 EXEC5588
1650 RETURN
1800 INPUT"MOVE HOW MANY:";N
1810 POKE5998,INT(N/256):POKE5999,N-(PEEK(5998)*256)
1820 PRINT"SET CURSOR FOR SOURCE":GOSUB1600:GOSUB400
1830 POKE5996,PEEK(5990):POKE5997,PEEK(5991):CLS
1840 PRINT"SET CURSOR FOR DESTINATION":GOSUB1600:GOSUB400
1850 POKE5994,PEEK(5990):POKE5995,PEEK(5991)
1860 EXEC5916
1870 RETURN
2000 CLS
2010 PRINT"C TO CLEAR MEMORY":PRINT"T TO LOAD TEXT":PRINT"P TO PRINT OUT":PRINT"
S TO DISPLAY":PRINT"W FOR CURRENT SCREEN":PRINT"I TO INSERT":PRINT"D TO DELETE":
PRINT"M TO MOVE BLOCK":PRINT"O TO OVERWRITE":PRINT"H FOR HELP":PRINT"Z FOR CODE"
2020 PRINT:PRINT"R TO RETURN FROM CURSOR"
2030 RETURN
2200 IF SC=0 THEN SC=1
2210 GOSUB1610
2220 RETURN
2400 CLS:PRINT"YOU CAN'T":RETURN
2600 INPUT"CODE:";C:A$=CHR$(C)
2610 FR=1:GOSUB1010:FR=0
2620 GOSUB810:A$="":RETURN
```

This is the alternative listing for lines 400-650 for controlling the cursor with the arrow keys. Please note that it is necessary to alter the printer prompts in lines 600 and 620 as shown to fit this substitute routine into available memory.

```
400 Q$=INKEY$:IFQ$="^"ANDV>0THENV=V-1
405 IFQ$=CHR$(10)ANDV<15THENV=V+1
410 IFQ$=CHR$(9)ANDH<31THENH=H+1
415 IFQ$=CHR$(8)ANDH>0THENH=H-1
420 CU=(1024+32*V+H):POKECU,159
430 CA=6000+(SC-1)*512+CU-1024
440 POKE5990,INT(CA/256):POKE5991,CA-(PEEK(5990)*256)
445 GOSUB1610
447 LI=256*PEEK(5992)+PEEK(5993)
450 IFQ$="R"THENRETURNELSE400
600 INPUT"BEGIN SCREEN:";N
605 N=6000+512*(N-1)
610 POKE5982,INT(N/256):POKE5983,N-(PEEK(5982)*256)
620 INPUT"# OF SCREENS:";N
630 POKE5984,N*2:POKE5985,0
640 EXEC5657
650 RETURN
```

Disassembled listing of the machine code.

```
         ORG   5588
COUNT    EQU   5998
SOURCE   EQU   5996
DESTIN   EQU   5994
LIMIT    EQU   5992
CADDR    EQU   5990
SSTART   EQU   5988
TSTART   EQU   5986
PCOUNT   EQU   5984
```

(listing continued on page 139)

DRAGON WORD PROCESSOR

The real keyboard on the Dragon just begs to be used with a word processor. With John Nash's software it need beg no more.

THIS SIMPLE word-processor program for the Dragon 32 provides the following functions: text load, display and print; insert, delete and overwrite; code input and block-move; double-size, new line and paragraph.

The program has been designed to leave the maximum available memory, so further refinements were not included. It leaves the addresses from 6000 decimal. to the top of memory clear, allowing storage of 26,768 characters, say 5-6,000 words.

Put in the machine code first. Either use a machine-code assembler, or input the decimal codes directly from a data statement. In either case, the code should be loaded from 5588 decimal. After this, save the code on to tape — CSaveM — type PClear1, and load the Basic program. Please do not add any spaces or Rems as memory is very tight. When the program is running, less than 250 bytes are left for the Basic system. Finally, save the Basic on to tape. This is the procedure to follow for first-time loading. For subsequent loading, type PClear1, load the Basic program, then load the machine code. Before running, type

CLEAR192,5588

to set the system limit.

When using the word processor, the program allows the input of lower case using the Shift0 convention. For double size use the up-arrow to open, and Shift up-arrow to close. New lines are put in with the Shift down-arrow key, while paragraphs are available on the Shift right-arrow key. Be careful to change back to upper case at the end of a line before entry, because the program will accept key commands only in upper case. It will not crash with a lower-case command, but you will get a blank screen, and have to type Shift0 before the program will respond.

To start the program, type Run. This starts storing from 6000. If you need to Break, restart with Goto 100 to continued from the current location, as Run will always re-initialise. The program will display a menu initially, and if H is pressed while running. Pressing T allows the storing of text in the memory, up to five lines or 160 characters at a time. The S key will display a screen of text, asking which one you want. Also included is a quick command, W, which displays the screen most recently requested.

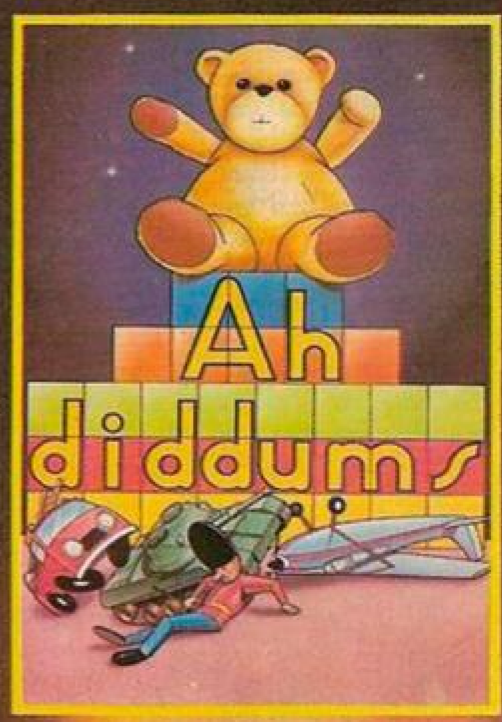
The I key will insert text under cursor control, asking for the text, screen and

(continued on page 139)

The decimal codes.

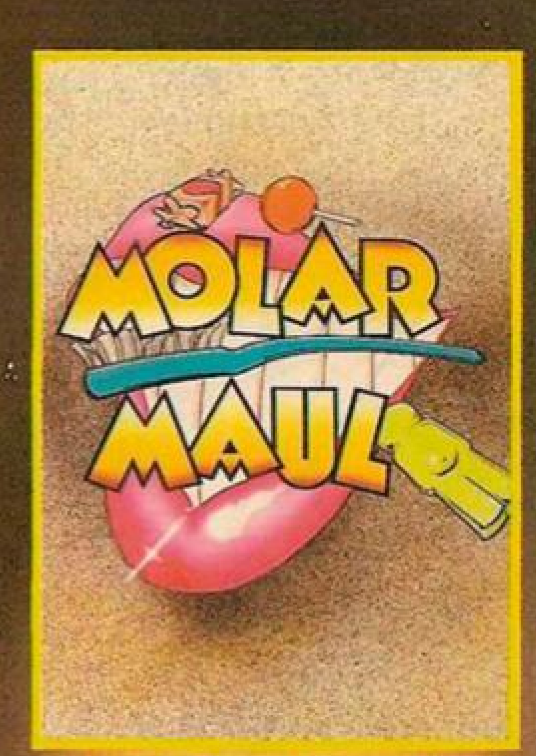
5588	142	4	0	16	190	23	100	206
5596	2	0	166	160	129	32	39	45
5604	129	33	39	41	129	39	39	37
5612	129	44	39	33	129	46	39	29
5620	129	58	39	25	129	59	39	21
5628	129	63	39	17	129	97	36	17
5636	167	128	51	95	17	131	0	0
5644	39	2	32	206	57	139	64	32
5652	239	128	96	32	235	254	23	96
5660	190	23	94	166	128	129	93	39
5668	38	129	91	39	30	129	94	39
5676	18	129	95	39	18	189	128	15
5684	51	95	17	131	0	0	39	2
5692	32	225	57	134	14	32	238	134
5700	15	32	234	134	10	32	230	134
5708	10	189	128	15	134	32	189	128
5716	15	134	32	189	128	15	134	32
5724	189	128	15	134	32	189	128	15
5732	134	32	32	201	254	23	110	190
5740	23	104	252	23	104	243	23	110
5748	253	23	104	48	1	16	190	23
5756	98	166	160	167	128	51	95	17
5764	131	0	0	39	2	32	242	57
5772	252	23	104	179	23	102	31	3
5780	51	65	190	23	104	252	23	104
5788	195	0	1	253	23	104	16	190
5796	23	104	48	1	49	33	166	130
5804	167	162	51	95	17	131	0	0
5812	39	2	32	242	252	23	110	131
5820	0	1	253	23	110	204	0	0
5828	16	179	23	110	39	2	32	192
5836	57	252	23	102	195	0	1	253
5844	23	102	252	23	104	179	23	102
5852	31	3	51	66	252	23	104	131
5860	0	1	253	23	104	190	23	102
5868	252	23	102	131	0	1	253	23
5876	102	16	190	23	102	166	128	167
5884	160	51	95	17	131	0	0	39
5892	2	32	242	252	23	110	131	0
5900	1	253	23	110	204	0	0	16
5908	179	23	110	39	2	32	187	57
5916	254	23	110	190	23	108	16	190
5924	23	106	166	128	167	160	51	95
5932	17	131	0	0	39	2	32	242
5940	57	254	23	110	190	23	102	16
5948	190	23	98	166	160	167	128	51
5956	95	17	131	0	0	39	2	32
5964	242	57	142	23	112	134	32	167
5972	128	140	127	255	36	2	32	247
5980	57	0	23	112	2	0	21	179

How are yours

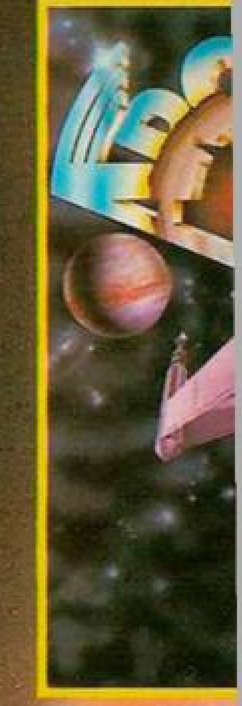


With Teddy
(for any ZX Spectrum)

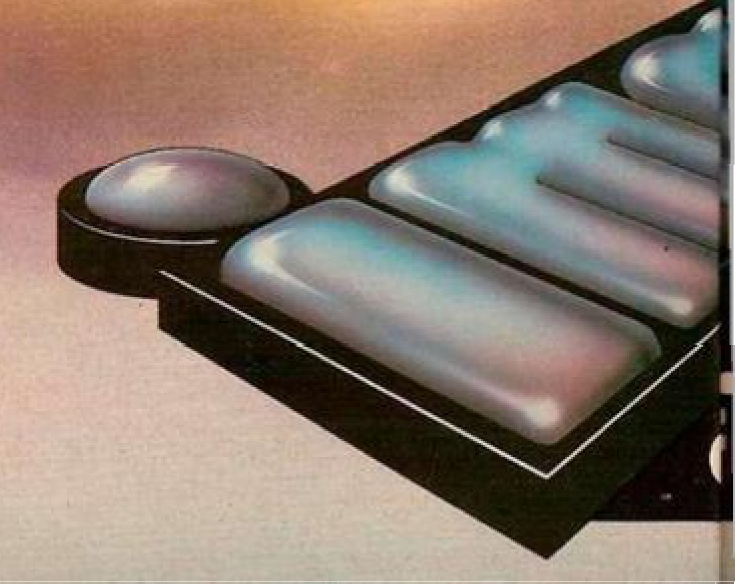
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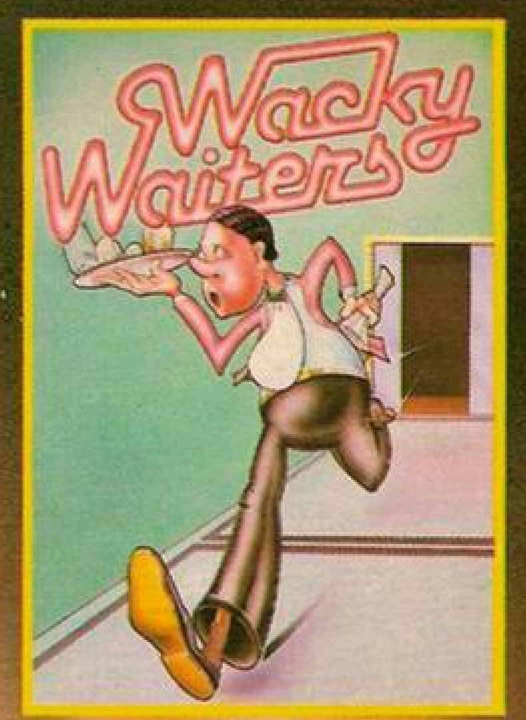
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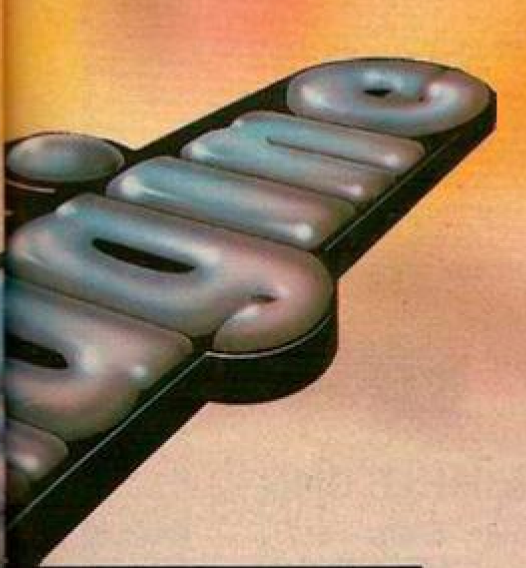
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With
Crime Fighting
(for any Commodore VIC-20)



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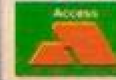
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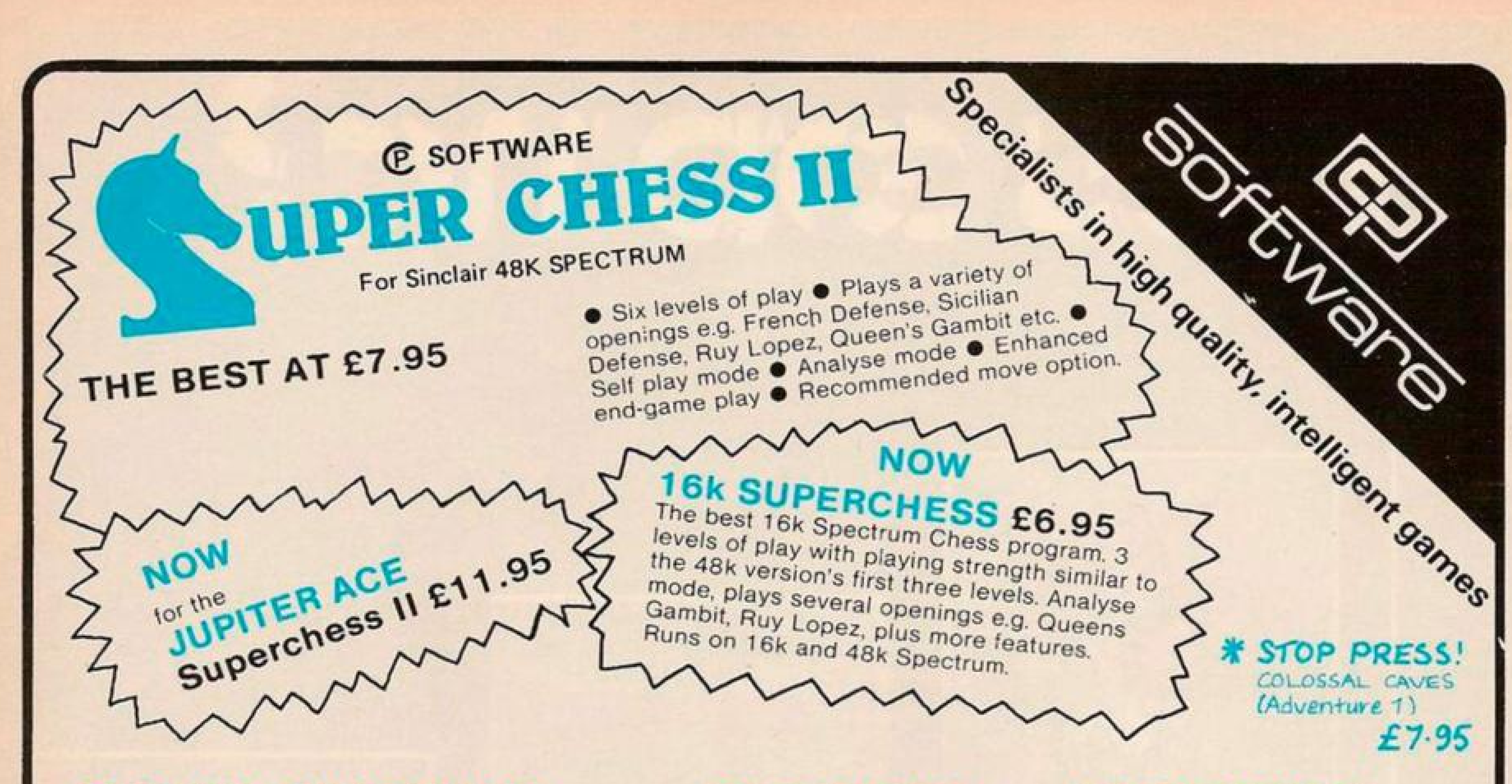
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(continued from page 135)

position. It is limited to 160 characters per operation. To delete the specified number of characters, again under cursor control, use the letter D.

The O key will overwrite up to 160 characters per operation, asking for the new text. This is also under cursor control. M will move a block of the specified number of characters, both the source and the destination being under cursor control. The P key prints out on the line printer, asking for the starting point and number of screens to print. If you want to interrupt this, you will have to press Reset, as the machine code is otherwise non-interruptible. To clear the text memory, press C.

The Z key allows the input of special characters not available from the keyboard, codes 160-222. which include some useful symbols. You can list these by typing

PRINT#-2,CHR$(X)

This is best done with a For-Next loop. This routine asks for one code, and then calls Overwrite. Pressing H will display the instructions.

The cursor is under joystick control for speed of operation. When it is correctly positioned, press R to return to the main program. Insert and Overwrite work to the right from the cursor, while Delete works to the left. After an alteration, press W to display the new version on the screen. The program is designed to use a joystick, but could be modified for keyboard control, using the arrow keys. A separate listing is shown for this purpose at the end of the main program.

Text can be stored in the form of machine-code cassette files, allowing 512 bytes per complete screen used. For example, for two screens, type

CCSAVEM"TEXT",5588,7023,1436

This will store the machine code and text, but the Basic must be stored separately.

How does it work? The Basic waits in an Inkey$ loop, and sets the relevant machine-code pointers and data addresses before transferring control to the appropriate machine-code subroutine. The machine code is very simple, consisting of routines to move blocks of character codes to the left or right as approriate. The printer commands could be easily adapted to other printers than the Seikosha GP-100A for which the program was written, but see your handbook to check whether the double-size codes are the same: 14 to enlarge, and 15 to revert to normal.

(listing continued from page 134)

```
00190 PSTART  EQU   5982
00200 SCREEN  LDX   #1024
00210         LDY   SSTART
00220         LDU   #512
00230 VLOOP   LDA   ,Y+
00240         CMPA  #32
00250         BEQ   CCH
00260         CMPA  #33
00270         BEQ   CCH
00280         CMPA  #39
00290         BEQ   CCH
00300         CMPA  #44
00310         BEQ   CCH
00320         CMPA  #46
00330         BEQ   CCH
00340         CMPA  #58
00350         BEQ   CCH
00360         CMPA  #59
00370         BEQ   CCH
00380         CMPA  #63
00390         BEQ   CCH
00400         CMPA  #97
00410         BHS   CCH2
00420 VBACK   STA   ,X+
00430         LEAU  -1,U
00440         CMPU  #0
00450         BEQ   VOUT
00460         BRA   VLOOP
00470 VOUT    RTS
00480 CCH     ADDA  #64
00490         BRA   VBACK
00500 CCH2    SUBA  #96
00510         BRA   VBACK
00520 PRINTO  LDU   PCOUNT
00530         LDX   PSTART
00540 PLOOP   LDA   ,X+
00550         CMPA  #93
00560         BEQ   PARAGR
00570         CMPA  #91
00580         BEQ   NEWLIN
00590         CMPA  #94
00600         BEQ   BIGST
00610         CMPA  #95
00620         BEQ   BIGFI
00630 PRINT   JSR   $800F
00640         LEAU  -1,U
00650         CMPU  #0
00660         BEQ   POUT
00670         BRA   PLOOP
00680 POUT    RTS
00690 BIGST   LDA   #14
00700         BRA   PRINT
00710 BIGFI   LDA   #15
00720         BRA   PRINT
00730 NEWLIN  LDA   #10
00740         BRA   PRINT
00750 PARAGR  LDA   #10
00760         JSR   $800F
00770         LDA   #32
00780         JSR   $800F
00790         LDA   #32
00800         JSR   $800F
00810         LDA   #32
00820         JSR   $800F
00830         LDA   #32
00840         JSR   $800F
00850         LDA   #32
00860         BRA   PRINT
00870 STORE   LDU   COUNT
00880         LDX   LIMIT
00890         LDD   LIMIT
00900         ADDD  COUNT
00910         STD   LIMIT
00920         LEAX  1,X
00930         LDY   TSTART
00940 SLOOP   LDA   ,Y+
00950         STA   ,X+
00960         LEAU  -1,U
00970         CMPU  #0
00980         BEQ   SOUT
00990         BRA   SLOOP
01000 SOUT    RTS
01010 INSERT  LDD   LIMIT
01020         SUBD  CADDR
01030         TFR   D,U
01040         LEAU  1,U
01050         LDX   LIMIT
01060         LDD   LIMIT
01070         ADDD  #1
01080         STD   LIMIT
01090         LDY   LIMIT
01100         LEAX  1,X
01110         LEAY  1,Y
01120 ILOOP   LDA   ,-X
01130         STA   ,-Y
01140         LEAU  -1,U
01150         CMPU  #0
01160         BEQ   INEXT
01170         BRA   ILOOP
01180 INEXT   LDD   COUNT
01190         SUBD  #1
01200         STD   COUNT
01210         LDD   #0
01220         CMPD  COUNT
01230         BEQ   IOUT
01240         BRA   INSERT
01250 IOUT    RTS
01260 DELETE  LDD   CADDR
01270         ADDD  #1
01280         STD   CADDR
01290 DELET2  LDD   LIMIT
01300         SUBD  CADDR
01310         TFR   D,U
01320         LEAU  2,U
01330         LDD   LIMIT
01340         SUBD  #1
01350         STD   LIMIT
01360         LDX   CADDR
01370         LDD   CADDR
01380         SUBD  #1
01390         STD   CADDR
01400         LDY   CADDR
01410 DLOOP   LDA   ,X+
01420         STA   ,Y+
01430         LEAU  -1,U
01440         CMPU  #0
01450         BEQ   DNEXT
01460         BRA   DLOOP
01470 DNEXT   LDD   COUNT
01480         SUBD  #1
01490         STD   COUNT
01500         LDD   #0
01510         CMPD  COUNT
01520         BEQ   DOUT
01530         BRA   DELET2
01540 DOUT    RTS
01550 BMOVE   LDU   COUNT
01560         LDX   SOURCE
01570         LDY   DESTIN
01580 MLOOP   LDA   ,X+
01590         STA   ,Y+
01600         LEAU  -1,U
01610         CMPU  #0
01620         BEQ   MOUT
01630         BRA   MLOOP
01640 MOUT    RTS
01650 OVERWR  LDU   COUNT
01660         LDX   CADDR
01670         LDY   TSTART
01680 OWLOOP  LDA   ,Y+
01690         STA   ,X+
01700         LEAU  -1,U
01710         CMPU  #0
01720         BEQ   OWOUT
01730         BRA   OWLOOP
01740 OWOUT   RTS
01750 CLEARM  LDX   #6000
01760         LDA   #32
01770 CLOOP   STA   ,X+
01780         CMPX  #$7FFF
01790         BHS   COUT
01800         BRA   CLOOP
01810 COUT    RTS
01820         END
```

■





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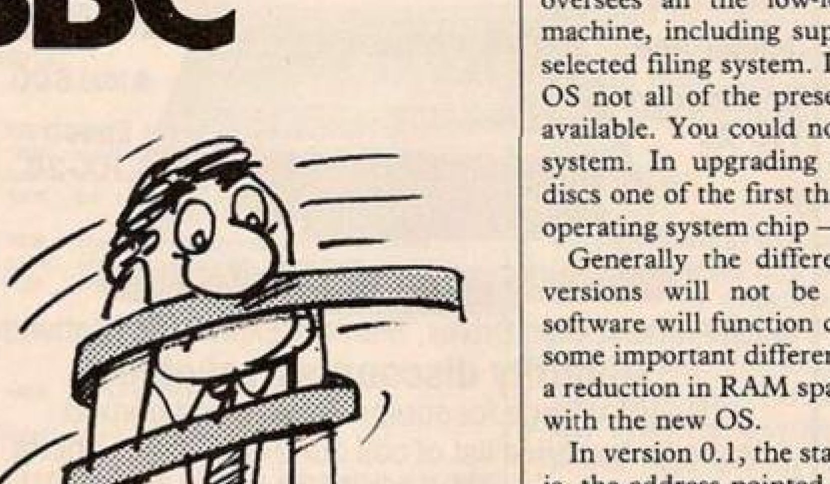
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TIED IN KNOTS? TRY A DISC

BBC

John Simpson unravels the red tape and illustrates methods of transferring cassette-based programs from tape to disc.



THE BBC COMPUTER has an extensive operating system resident in a chip. The OS oversees all the low-level functions of the machine, including supporting the currently-selected filing system. In early versions of the OS not all of the present OS functions were available. You could not run a disc operating system. In upgrading your BBC to include discs one of the first things to do is get a new operating system chip — currently version 1.2.

Generally the differences between the OS versions will not be noticed and existing software will function correctly. But there are some important differences and one of these is a reduction in RAM space available to the user with the new OS.

In version 0.1, the start of user RAM — that is, the address pointed to by Page in Basic — was &0E00 giving a user RAM space of 27.5K in Mode 7. The 1.2 OS sets Page to &1900, reducing user RAM by 2.75K to 24.75K in Mode 7. This means that very long programs written for the old OS may not fit into RAM under the new version. This can be overcome, if using cassette, by just setting Page back to &0E00 after power up or Break. Programs will then load in as though the old OS was in control, and run normally.

A more serious problem occurs if discs are used. The RAM between &0E00 and & 1900 is used by the disc-filing system for buffer space during disc reads and writes. Obviously this space cannot be overwritten by a program being loaded if the disc system is still expected to function correctly.

Why not just load a program at the new Page address then? This is acceptable for pure Basic programs as they are fully relocatable in memory and will function anywhere in RAM. Machine code is another matter. In general, machine, code is "located" at assembly time to a particular address and must be loaded there to run correctly. The same problems occur with Basic programs that have a piece of "invisible" machine code appended on to the

(continued on page 143)

Listing 1.

```
 10 REM  GAME1
 20
 30 REM  J Simpson  28/01/83
 40
 50 REM  Loader for a mixed BASIC/
 60 REM  Machine code type program
 70 REM  for DISC System use.
 80
 90 REM  ****************************
100 MODE7
110 REM  Relocate this program to high
120 REM  memory and restart it.
130
140 IF PAGE=&1900 THEN PAGE=&6000:
    CHAIN"GAME1"
150
160 REM  ****************************
170
180 REM  This is where the game's
190 REM  initialisation code goes.
200
210 REM  ****************************
220
230 REM  Load the game machine code...
240
250 *LOAD"Game1obj" 1900
260
270 REM  ...and move it to &E00 as in
280 REM  a TAPE filing system.
290
300 PROCMOVE
310
320 REM  The next line starts the game
330 REM  machine code.
340 REM  The actual Hex number in
350 REM  Line 390 is the EXECUTION
360 REM  address given by the TAPE
370 REM  filing system.
380
390 CALL &8000
400
410 REM  ****************************
420
430 REM  This procedure assembles
440 REM  machine code to move the game
450 REM  code down to where it would
460 REM  be in a TAPE filing system.
470
480 DEFPROCMOVE
485 REM  I.Birnbaum's mover routine
490 SIZE=&70:SOURCE=&72:DEST=&74
500 DIM STARTMOVE 40
510 FOR I%=0 TO 2 STEP 2:P%=STARTMOVE
520    [OPT I%
530    LDY £0
540    LDX SIZE+1
550    BEQ LOOP1
560    .LOOP
570    LDA (SOURCE),Y
580    STA (DEST),Y
590    INY
600    BNE LOOP
610    INC SOURCE+1
620    INC DEST+1
630    DEX
640    BNE LOOP
650    .LOOP1
660    LDX SIZE
670    BEQ DONE
680    .LOOP1
690    LDA (SOURCE),Y
700    STA (DEST),Y
710    INY
720    DEX
730    BNE LOOP1
740    .DONE
750    RTS
760    ]:NEXT
770
780
790 REM  The Size value in Line 830 is
800 REM  also obtained from the TAPE
810 REM  filing system.
830 !SIZE=&3000:!SOURCE=&1900:
    !DEST=&0E00
840 CALL STARTMOVE
850 ENDPROC
```

(continued from page 141)

end. Here the Basic program must be loaded at the correct address to ensure that the machine code is also properly located.

Several solutions have already appeared in magazines; for the most part proving slow, or cumbersome, or have only worked with pure Basic programs. I have developed solutions which allow fast loading of Basic, machine code or combinations of these, without using a function key.

Listing 2.

```
10 REM GAME2
20 REM Loader for a 'Long'
30 REM machine code program
40 REM J Simpson 28/01/83
50
60 IF PAGE=&1900THEN PAGE=&900:
   HIMEM=&800:CHAIN"GAME2"
70 CLS:VDU 28,1,22,38,18
80 PRINTCHR$141"ADVENTURE":PRINTCHR$141
   "ADVENTURE"'CHR$136"LOADING..."
90 *LOAD"Game2obj" 1100
100 !&70=&6DFF:!&72=&1100:!&74=&0E00
110 *RUN"$.MOVR"
120 VDU26,12
130 CALL&8000
```

Listing 3.

```
10 REM  MOVER
20
30 REM  This program assembles a
40 REM  machine code "mover" which
50 REM  allows TAPE based programs
60 REM  to run on a DISK system
70
80 REM  The mover program executes
90 REM  from the User Defined
100 REM  Character buffer space.
110
120 REM  J Simpson  28/01/83
130
140
150 REM  **************
160
170 REM  Variables:
180
190 SIZE=&70:REM NUMBER OF BYTES TO MOVE
200 SOURCE=&72:REM SOURCE POINTER
210 DEST=&74:REM DESTINATION POINTER
220 REM  I.Birnbaum's mover routine
230 REM  **************
240 FOR I%=0 TO 3 STEP 3:P%=&C00
250   [OPT I%
260   LDY £0
270   LDX SIZE+1
280   BEQ LOOP1
290   .LOOP
300   LDA (SOURCE),Y
310   STA (DEST),Y
320   INY
330   BNE LOOP
340   INC SOURCE+1
350   INC DEST+1
360   DEX
370   BNE LOOP
380   .LOOP1
390   LDX SIZE
400   BEQ DONE
410   .LOOP1
420   LDA (SOURCE),Y
430   STA (DEST),Y
440   INY
450   DEX
460   BNE LOOP1
470   .DONE
480   \ Restore HIMEM & PAGE to normal
490   LDA £0
500   STA &06    \ HIMEM=&7C00
510   LDA £&7C
520   STA &07
530   LDA £&0E
540   STA &18    \ PAGE=&0E00
550   RTS:]NEXTI%
560
570 END
```

NEW Y.C. WAMMO DRIVES OUT THOSE GRUBBY LOADING PROBLEMS!

NEW WAMMO Y.C. LOADER

There are fundamentally three types of program that require the use of a loader to operate with the disc system. I will consider each separately. I have used for examples the program structure found in some commonly available popular programs for the model B. The loaders presented can be used for other, similar programs.

Firstly the required program must be loaded from cassette on to disc. Some additional information to that normally given by the tape-filing system must be obtained about the program being loaded. Luckily, this can be obtained by following the information given on page 398 of the User Guide. Here, almost hidden from sight is how to find the Length, Load and Execution Addresses for any tape file.

By typing

```
*OPT 1,2
```

the tape-filing system will give the required information as the tape is loaded. It is best to use

```
*LOAD "" 1900
```

to load the program — Basic or machine code — from tape. You then know where the data is and can be sure that the disc-filing system will not overwrite anything. After loading, the screen will display a row of hexadecimal numbers in the following format:

```
filename BB LLLL SSSSSSSS FFFFFFFF
EEEEEEEE
```

The meaning of these numbers is:

BB	Number of blocks — a block is 256 bytes long
LLLL	length in bytes
SSSSSSSS	Start address of data — if *Loaded with no over-ride address
FFFFFFFF	Finish address of data
EEEEEEEE	Execution address — this will usually be FFFF801F for a Basic program

Note that only the right-hand four hexadecimal characters need to be used in during a subsequent *Save to disc; all eight characters represent a 32-bit address needed for future BBC system expansion.

To store the data on disc switch back to the DFS by typing

```
*DISC
```

followed by

```
*SAVE filename 1900 +LLLL EEEE
```

using the numbers obtained during loading. See page 392 of the User Guide if unsure of this procedure.

If the program is so long that it will not fit into memory from &1900 it is possible to load it at &1100 instead. However make sure that you do not use any DFS function other than *Save or *Load until you have the program safely written to disc. Even the use of *Cat will overwrite some bytes between &1100 and &1900.

We can now turn to the techniques involved in running the program from disc. Programs generally fall into one of three types, each of which is given in the following examples.

The short Basic plus machine-code type of program has a short piece of Basic to, for example, set up Envelopes for the Sound function, or to define user graphics characters. The main machine code is then *Loaded and a Call is made to the machine code's Execution address. Many arcade-type games use this technique. To use this type of program with discs some modifications are made to the short Basic program as shown in listing 1.

There are six main points to note from this listing. First, line 140 relocates this program up into high memory, well clear of the machine code to be *Loaded from disc. Second, lines 160 to 210 are where the original arcade game initialisation code was. You will have to replace these statements from your own tape version of the program. Third, line 250 *Loads the machine code starting at &1900 which is clear of the disc I/O buffer space. Point four is that line 300 calls a procedure to move the game machine code to the place it would normally occupy in a tape-based system. Note that after this point the disc system cannot be used again without corrupting the relocated machine code. Next, line 830 sets up the number of bytes to move and the source/destination addresses. This "number of bytes" data is obtained when the original program is loaded from tape as explained earlier. Finally line 390 starts the main machine-code program. This line was in the original Basic loader program but it could also be obtained from the Execution address field from the tape-filing system.

For my next example, long machine-code programs are typified in several Adventure games. The program is a very long machine-code program — over 6DFF bytes — and almost fills up all available memory in Mode 7, using the tape-filing system. It would thus appear impossible to load and run this type of program from disc. However a small quirk in the disc-filing system allows everything to fit into memory. Refer to listing 2 to see how this loader works.

The key to the solution is that, if using discs just for *Loading programs, memory upwards from &1100 can be used for user programs, rather than &1900 as is the case when other disc functions are performed. The other important point can be seen in line 60 of listing 2.

Here a similar trick to that used in listing 1 is used to relocate the loader program into a safe area of memory. In this case, however, the Basic program of listing 2 is moved into the unused RS-423 buffer space. Himem is set to the end of this space which prevents Basic's stack destroying any of our large machine-code program, before it is moved to the correct place in memory. You should also note that line 70 clears screen memory and sets up a text window near the bottom of the screen. This is required because the machine-code program being read from disc is so large that it temporarily lies within the screen memory area; you will see it flash on to the screen for a couple of seconds before it is moved down in memory.

Line 100 sets up parameters for the actual mover program which is called by line 110. Because of space limitations, the routine which was Procmove in listing 1 has been separately assembled and is saved on disc as a program called Movr. The assembly is accomplished by listing 3 which produces a small machine-code mover located at address &0C00 — the user-defined character buffer.

(continued on next page)

(continued from previous page)

Page zero memory locations &70-&75 are used as before for storing the size, source, and destination variables as used by listing 1. Movr should be *Saved on the same disc as the main program to be laoded. This is accomplished by typing

*SAVE MOVR 0D00 +30

after running listing 3.

Once the target machine-code program has been moved to the correct place in memory it is run by line 130. As before this address can be obtained by using the Tape-filing system Execution Address data.

The last type of program, the long Basic program is seen in several Adventure games. The method required here is similar to the previous case, with a few changes to ensure that the Basic interpreter has its pointers set up correctly, before the final relocated program is executed.

The program in listing 4 is used to load and relocate the Basic code. Lines 10 to 100 perform identical functions to those in listing 2. In lines 120 to 190 repeated use of

*FX138

is used to load

O L D <C R> R U N <C R>

into the keyboard buffer. Then the machine code mover program is run to shift the long Basic program down in memory. When a return is made from the mover the keyboard contents are sent to the Operating System as though directly typed in. Old resets Basic's pointers which will now refer to the large program located at &0E00. Run then executes that program.

The techniques used in listings 1 to 4 can be adapted to run virtually any program on a disc-based BBC computer.

Bear in mind that when the program has been moved down in memory the disc system will no longer be able to operate as its I/O buffer space is overwritten. Any use of disc functions will overwrite some of the program and will require that a Break be done to restart the computer. ■

Listing 4.

```
 10 REM GAME3
 20 REM Loader for a 'Long' BASIC
 30 REM program for DISC
 40 REM D Simpson 28/01/83
 50
 60 IF PAGE=&1900THEN PAGE=&900:
    HIMEM=&B00:CHAIN"GAME3"
 70 CLS:VDU 28,1,22,38,15
 80 PRINTCHR$141"ADVENTURE":PRINTCHR$141
    "ADVENTURE":PRINT'CHR$136"LOADING..."
 90 *LOAD"Game3obj" 1900
100 !&70=&6400:!&72=&1900:!&74=&0E00
110 REM PUT "OLD RUN" in key buffer
120 *FX138,0,79
130 *FX138,0,76
140 *FX138,0,68
150 *FX138,0,13
160 *FX138,0,82
170 *FX138,0,85
180 *FX138,0,78
190 *FX138,0,13
200 *RUN"$.MOVR"
```






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THE CARDS OF FATE

Chris Somerville and his ZX-81 delve into the occult mysteries.

THE GYPSY TELLS is a fortune-telling program with a bit of mind-reading thrown in. It has proved very popular at parties, and not only with the ladies. The text is based on genuine cartomancy and is held in a string array, C$. This can be altered at any time without interfering with the listing. Thus you can change or personalise the data as you wish.

The program lines are typed in as usual. Since graphics characters are not easily read from a listing, the title graphics are illustrated as they appear. These should be entered using the entry program — lines 9100 to 9203. The picture will gradually build up on the screen. Mistakes can be quickly spotted and easily rectified. This useful program can also be used to enter the text for the string array C$. Remember that whatever you enter via the entry program is contained in B$ and must be re-allocated by direct command, to

T$(LET T$ = B$)

in the case of the graphics, or for text to

C$(x)

Now find your destiny in the Cards of Fate.

```
THE T$ GRAPHIC STRING SHOULD BE
DIRECTLY ENTERED.

T$=
        THE
GYPSY      TELLS
EXPLORING       THE ANCIENT
ARCANE          SECRETS

   5 SLOW
  10 PRINT T$
  11 PRINT "
  12 PRINT "
                           OF
                       ROMANY
                         LORE
"
  15 PRINT AT 21,0;"        PRESS N
EWLINE TO BEGIN"
  20 INPUT H$
  45 CLS
  50 PRINT "
               IN CARTOMANCY-THE TE
CHNICAL NAMEFOR DIVINATION BY PL
AYING CARDS-WE USE THE ACES,PICT
URE CARDS    AND ALL SPOT CARDS V
ALUED AT     SEVEN OR OVER.

               IF YOU WISH TO CONSU
LT THE CARDSPLEASE MENTALLY CHOO
SE A CARD."
  51 PRINT "IT MAY BE ANY CARD,
OF ANY SUIT.BUT IT MUST BE A SEV
EN OR HIGHER
               PRESS NEWLINE WHEN Y
OU HAVE      DECIDED UPON YOUR CA
RD
"
  52 INPUT H$
  53 CLS
  55 PRINT AT 6,0;"
                        NOW WE MUS
T FIX THAT CARD           FIRMLY I
N YOUR MIND
                      SEARCH FOR
YOUR CARD IN THE              FOLLO
WING LISTS
"
  60 PAUSE 250
  70 CLS
 100 LET POT=0
 101 LET TOT=1
 105 FOR J=1 TO 5
 120 PRINT "      CAN YOU SEE YOU
R CARD?      "
 121 PRINT "
"
 140 PRINT L$(J)
 145 PRINT "
"
 160 PRINT AT 20,0;"CAN YOU SEE
YOUR CARD? ENTER     ""YES"" OR "
"NO"" ,THEN PRESS NEWLINE"
 170 INPUT H$
 171 IF H$="" THEN GOTO 53
 175 CLS
 195 IF J>1 THEN LET TOT=TOT*2
 197 IF CODE H$=62 THEN LET POT=
POT+TOT
 210 NEXT J
 220 IF POT<1 THEN GOSUB 7000
 230 PRINT AT 6,0;"
"
 235 PRINT "YOU SHOULD HAVE YOUR
 CHOSEN CARDFIRMLY IN MIND NOW."
 240 PRINT "
"
 245 PRINT "THE CARD YOU ARE THI
NKING OF IS KNOWN AS THE
"
 247 PRINT "
"
 250 PAUSE 250
 360 CLS
 370 PRINT "YOU ARE THINKING OF
THE....."
 380 PAUSE 80
 390 PRINT AT 9,0;C$(POT,1 TO 32
)
 400 PRINT "                    "
 410 PRINT "THIS IS THE SIGNIFIC
ATOR.
"
 420 PRINT AT 21,0;"PRESS NEWLIN
E TO LEARN MORE."
 430 INPUT H$
 440 CLS
 450 PRINT "
"
 460 PRINT "THE SIGNIFICATOR IND
ICATES THAT "
 470 PRINT C$(POT,33 TO 96)
 480 PRINT "WILL PROVE OF IMPORT
ANCE TO YOU ESPECIALLY IN "
 490 PRINT C$(POT,97 TO 160)
 500 PRINT "
"
 510 PRINT AT 21,0;"PRESS NEWLIN
E TO LEARN MORE."
 520 INPUT H$
 525 CLS
 530 PRINT AT 9,0;"
 540 PRINT "
 550 PRINT "
"
 560 DIM A(32)
   0 REM
 570 FOR I=1 TO 32
 580 LET A(I)=I
 590 NEXT I
 595 CLS
 597 FOR J=1 TO 2
 600 FOR I=1 TO 32
 610 LET R=INT ((RND*32)+1)
 620 LET X=A(I)
 630 LET A(I)=A(R)
 640 LET A(R)=X
 650 LET V=A(I)
 655 PRINT "      ";C$(V, TO 17
);"      "
 660 IF I=21 OR I=32 THEN CLS
 670 NEXT I
 680 NEXT J
 700 PRINT AT 6,0;"
E COMPLETED  "
 710 PRINT "
"
 720 PRINT
 730 PRINT
 740 PRINT "
"
 750 LET A=A(1)
 760 LET B=A(2)
 770 LET C=A(3)
 780 LET D=A(4)
 790 INPUT H$
 800 CLS
1000 PRINT "          THESE ARE YOUR
"
1010 PRINT "
"
1020 PRINT "
"
1030 PRINT "
"
1040 INPUT H$
1050 PRINT AT 3,4;"          ";C$(A,
TO 17)
1060 PRINT AT 5,4;"     "
1070 INPUT H$
1080 PRINT AT 7,4;"      "
1090 PRINT AT 8,4;"      ";C$(B,
TO 17)
1100 PRINT AT 9,4;"      "
1110 INPUT H$
1120 PRINT AT 11,4;"     "
1130 PRINT AT 12,4;"     ";C$(C,
 TO 17)
1140 PRINT AT 13,4;"     "
1145 INPUT H$
1150 PRINT AT 15,4;"      "
1160 PRINT AT 16,4;"      ";C$(D,
 TO 17)
1170 PRINT AT 17,4;"      "
1175 PAUSE 100
1180 PRINT AT 19,6;"NOW PRESS NE
WLINE TO"
1190 PRINT AT 20,8;"TO READ THE
CARDS"
1200 INPUT H$
1205 CLS
1210 PRINT "
"
1215 PRINT "
E PAST         "
1220 PRINT C$(A, TO 17)
1230 PRINT "
"
1240 PRINT C$(A,33 TO 96)
1250 PRINT "
"
1260 PRINT C$(A,97 TO )
1270 PRINT "
"
1280 PRINT AT 21,0;"PRESS NEWLIN
E TO LEARN MORE"
1290 INPUT H$
1300 CLS
1310 PRINT "
PRESENT
"
1320 PRINT C$(B, TO 17)
1330 PRINT "
"
1340 PRINT C$(B,33 TO 96)
1350 PRINT "
"
1360 PRINT C$(B,97 TO )
1370 PRINT "
"
1380 PRINT AT 21,0;"PRESS NEWLIN
E TO LEARN MORE."
1390 INPUT H$
1400 CLS
1500 PRINT "
"
1510 PRINT C$(C, TO 17)
1520 PRINT C$(D, TO 17)
1530 PRINT "
"
1540 PRINT C$(C,33 TO 96)
1550 PRINT "
"
1560 PRINT C$(D,33 TO 96)
1570 PRINT "
"
1580 PRINT C$(C,97 TO )
1590 PRINT "
"
1600 PRINT C$(D,97 TO )
1610 PRINT "
"
1620 PRINT AT 21,0;"PRESS NEWLIN
E WHEN READY."
1630 INPUT H$
1640 CLS
1650 PRINT AT 5,0;"
"
1660 PRINT "
           THEN PRESS NEWLINE
"
1670 INPUT H$
1675 IF H$="" THEN GOTO 1640
1680 CLS
1690 IF VAL H$=1 THEN GOTO 1205
1700 IF VAL H$=2 THEN GOTO 1
1710 IF VAL H$=3 THEN PRINT AT 1
1,11;"GOOD LUCK"
1720 PRINT AT 19,0;"THIS PROGRAM
ME IS FOR AMUSEMENT    ONLY.WE HO
PE YOU HAVE BEEN
 AMUSED."
6999 STOP
7000 PRINT AT 6,0;"
                   WAS YOUR CARD
                   AN ODD NUMBER
ED CARD?
"
7010 PRINT "PLEASE ENTER YES OR
NO, AND THENPRESS NEWLINE.
"
7020 INPUT H$
7025 IF H$="" THEN GOTO 7000
7030 IF CODE H$=62 THEN LET POT=
32
7040 IF CODE H$=51 THEN LET POT=
31
7045 CLS
7050 RETURN
7999 STOP
8000 CLS
8010 SAVE "G"
8020 GOTO 5
```

(continued on page 149)



....Introducing the AGF JOYSTICK INTERFACE II for sinclair ZX Spectrum 81

ABOUT OUR JOYSTICK INTERFACE

Following in the footsteps of our extremely popular original interface, which has sold over 1,000 worldwide since October last year, we have improved its performance.

The Interface Module II has been specially designed to plug on to the rear connector of your ZX Spectrum or ZX81 and allow you to connect any standard Atari type digital Joysticks. All of the computer's connections are duplicated on an extension connector so that you can still use any other devices intended for use with your computer.

The Interface Module II resides in the same memory space as the keyboard, which remains fully functional at all times, therefore it will not interfere with anything else connected.

When a suitable joystick is plugged into 'Player 1' socket its action will mimic pressing the cursor keys, up "7", left "5" and so on. The firing button will simulate key ϕ. This unique feature guarantees the best software support.

Take a look at the selection of compatible games we have listed. More are being added all the time as a result of our contact with the various software companies.

A second Joystick may be connected in the 'Player 2' position which simulates in a parallel fashion keys T-Y-U-I-P. This will allow you to play a whole new generation of two player games.

An added advantage of using our Joystick Interface is that you relieve your keyboard of the key-thumping strain of game playing whilst increasing the enjoyment.

Using joystick control in your own programs is as easy as reading keys. Eight directions and Fire are all read by simple BASIC. With every order there comes a free demonstration program called 'Video Graffiti' plus a full set of instructions.

KEY FEATURES

- ⋆ Proven cursor key simulation for maximum software support
- ⋆ Accepts Atari, Competition Pro, Wico, Starfighter, Le Stick, etc Joysticks
- ⋆ Second Joystick facility
- ⋆ Eight directions programmed in simple BASIC
- ⋆ Rear extension connector for all other add-ons
- ⋆ Free demo program, 'Video Graffiti' + full instructions

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	☐ 3D Tunnel	£5.95
Psion	* Flight Simulation	
	VU–3D	
Silversoft	Ground Attack	
	☐ Cyber Rats	£5.95

ZX81

Artic	Galaxians
J.K. Greye	3D Monster Maze
P.S.S.	Krazy Kong
	Ghost Hunt
	Maze Drag Race
Silversoft	Asteroids

NB ☐ *Available from us, please tick*
* *Not suitable for original interface*

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ZX81 ☐	ZX SPECTRUM ☐ Please tick	FINAL TOTAL	

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(continued from page 147)

```
FIRST DIM C$(32,160)
THEN ENTER TEXT BY
DIRECT COMMAND

C$(1) =
ACE OF    HEARTS.
GOOD NEWS. ROMANTIC AND/OR
DOMESTIC HAPPINESS.
THE EMOTIONS AND AFFECTIONS.
FRIENDSHIP,FAMILY AND MARRIAGE

C$(2) =
KING OF   HEARTS.
A HANDSOME MAN OF GENEROUS
NATURE. PROBABLY FAIR.
THE EMOTIONS AND AFFECTIONS.
FRIENDSHIP,FAMILY AND MARRIAGE

C$(3) =
QUEEN OF HEARTS.
A KIND GENEROUS AND LOVING
WOMAN.PROBABLY FAIR COMPLEXION.
THE EMOTIONS AND AFFECTIONS.
FRIENDSHIP,FAMILY AND MARRIAGE

C$(4) =
JACK OF   HEARTS.
FRIEND OR LOVER. PERHAPS NOT
ENTIRELY TO BE TRUSTED?
THE EMOTIONS AND AFFECTIONS.
FRIENDSHIP,FAMILY AND MARRIAGE

C$(5) =
TEN OF    HEARTS.
SUCCESS. HAPPINESS. UNEXPECTED
GOOD FORTUNE.
THE EMOTIONS AND AFFECTIONS.
FRIENDSHIP,FAMILY AND MARRIAGE

C$(6) =
NINE OF   HEARTS.
A HAPPY OUTCOME. HOPES COME TO
FRUITION.
THE EMOTIONS AND AFFECTIONS.
FRIENDSHIP,FAMILY AND MARRIAGE

C$(7) =
EIGHT OF HEARTS.
DOMESTIC CONTENT. AN INVITATION.
A JOURNEY. A VISIT.
THE EMOTIONS AND AFFECTIONS.
FRIENDSHIP,FAMILY AND MARRIAGE

C$(8) =
SEVEN OF HEARTS.
A FEELING OF CONTENTMENT.
CONTENTMENT IN MARRIAGE.
THE EMOTIONS AND AFFECTIONS.
FRIENDSHIP,FAMILY AND MARRIAGE

C$(9) =
ACE OF    SPADES.
A LOVE OR BUSINESS PROPOSITION.
LEGAL MATTERS.
MISFORTUNE.WARNINGS.ENEMIES.
SCANDAL.SUFFERING.BETRAYAL.LOSS.

C$(10) =
KING OF   SPADES.
A MAN OF THE LAW. HIS ADVICE
MAY NOT BE TO YOUR ADVANTAGE.
MISFORTUNE.WARNINGS.ENEMIES.
SCANDAL.SUFFERING.BETRAYAL.LOSS.

C$(11) =
QUEEN OF SPADES.
A CRAFTY LADY. SUBTLE. A WIDOW
OR DIVORCEE PERHAPS?
MISFORTUNE.WARNINGS.ENEMIES.
SCANDAL.SUFFERING.BETRAYAL.LOSS.

C$(12) =
JACK OF   SPADES.
A DARK YOUNG MAN. DEVIOUS.
COULD BE CAPABLE OF TREACHERY.
MISFORTUNE.WARNINGS.ENEMIES.
SCANDAL.SUFFERING.BETRAYAL.LOSS.

C$(13) =
TEN OF    SPADES.
A LETTER CAUSES WORRY. A
JOURNEY. CONFINEMENT OF SORTS?
MISFORTUNE.WARNINGS.ENEMIES.
SCANDAL.SUFFERING.BETRAYAL.LOSS.

C$(14) =
NINE OF   SPADES.
FAILURE
MISFORTUNE.
MISFORTUNE.WARNINGS.ENEMIES.
SCANDAL.SUFFERING.BETRAYAL.LOSS.

C$(15) =
EIGHT OF SPADES.
BAD NEWS.
SORROW.
MISFORTUNE.WARNINGS.ENEMIES.
SCANDAL.SUFFERING.BETRAYAL.LOSS.

C$(16) =
SEVEN OF SPADES.
QUARRELS AND FRICTION.
UNWANTED ADVICE OR CRITICISM.
MISFORTUNE.WARNINGS.ENEMIES.
SCANDAL.SUFFERING.BETRAYAL.LOSS.

C$(17) =
ACE OF    DIAMONDS.
IMPORTANT DOCUMENT/LETTER.
JEWELLERY-COULD BE A RING?
WORLDLY AFFAIRS. GENERAL
MATTERS-NO PERSONAL CONTROL.

C$(18) =
KING OF   DIAMONDS.
A MAN OF AUTHORITY. POWERFUL
AND STRONG.
WORLDLY AFFAIRS. GENERAL
MATTERS-NO PERSONAL CONTROL.

C$(19) =
QUEEN OF DIAMONDS.
A SPITEFUL WOMAN. POSSIBLY
GOOD-LOOKING. BUT UNDERNEATH?
WORLDLY AFFAIRS. GENERAL
MATTERS-NO PERSONAL CONTROL.

C$(20) =
JACK OF   DIAMONDS.
A UNIFORMED MAN.
A MESSENGER OR MESSAGE.
WORLDLY AFFAIRS. GENERAL
MATTERS-NO PERSONAL CONTROL.

C$(21) =
TEN OF    DIAMONDS.
A CHANGE OF SOME KIND WHICH
COULD INVOLVE A JOURNEY.
WORLDLY AFFAIRS. GENERAL
MATTERS-NO PERSONAL CONTROL.

C$(22) =
NINE OF   DIAMONDS.
NEWS. CONCERNING MONEY OR THE
LATEST ENTERPRISE?
WORLDLY AFFAIRS. GENERAL
MATTERS-NO PERSONAL CONTROL.

C$(23) =
EIGHT OF DIAMONDS.
SHORT JOURNEYS. USUALLY
PLEASANT.
WORLDLY AFFAIRS. GENERAL
MATTERS-NO PERSONAL CONTROL.

C$(24) =
SEVEN OF DIAMONDS.
SURPRISING ,HURTFUL CRITICISM.
AN UNEXPECTED GIFT.
WORLDLY AFFAIRS. GENERAL
MATTERS-NO PERSONAL CONTROL.

C$(25) =
ACE OF    CLUBS.
FINANCIAL SUCCESS.
SUCCESS IN OTHER FIELDS.
FRIENDSHIP,LOYALTY,MONEY. WORRY,
ANXIETY,BETRAYAL.

C$(26) =
KING OF   CLUBS
A HELPFUL,FRIENDLY MAN.
PROBABLY DARK. AN OLDER MAN.
FRIENDSHIP,LOYALTY,MONEY. WORRY,
ANXIETY,BETRAYAL.

C$(27) =
QUEEN OF CLUBS.
AN AFFECTIONATE,HELPFUL WOMAN.
POSSIBLY A WIDOW.
FRIENDSHIP,LOYALTY,MONEY. WORRY,
ANXIETY,BETRAYAL.

C$(28) =
JACK OF   CLUBS.
A YOUNG MAN. POSSIBLY DARK.
SINCERE IN MATTERS OF AFFECTION.
FRIENDSHIP,LOYALTY,MONEY. WORRY,
ANXIETY,BETRAYAL.

C$(29) =
TEN OF    CLUBS
UNEXPECTED MONEY. A PRIZE?
LEGACY? A RISE?
FRIENDSHIP,LOYALTY,MONEY. WORRY,
ANXIETY,BETRAYAL.

C$(30) =
NINE OF   CLUBS.
A GOOD MARRIAGE.
FINANCIAL ADVANTAGE.
FRIENDSHIP,LOYALTY,MONEY. WORRY,
ANXIETY,BETRAYAL.

C$(31) =
EIGHT OF CLUBS.
JOY,GOOD FORTUNE. OFTEN BROUGHT
BY YOUNG GIRL OR WOMAN. DARK.
FRIENDSHIP,LOYALTY,MONEY. WORRY,
ANXIETY,BETRAYAL.

C$(32) =
SEVEN OF CLUBS.
A SMALL CHILD. PERHAPS SOME
ASSOCIATION WITH MONEY. A GIFT.
FRIENDSHIP,LOYALTY,MONEY. WORRY,
ANXIETY,BETRAYAL.

9100 REM TEXT OR GRAPHIC ENTRY
         ROUTINE.INCOMPLETE
         LINES MAY BE ENTERED
         AND WILL BE MADE UP
         TO COMPLETE LINES WITH
         SPACES.FINAL GRAPHIC
         OR TEXT HELD AS B$.
9101 REM WHEN ENTERING TEXT USE
     "ENTER" AS THE RETURN KEY
      ON A TYPEWRITER.
9102 REM ENTER "ERROR" TO DELETE
     INCORRECT LINES
     ENTER "STOP" WHEN GRAPHICS
       ARE COMPLETE /
9103 CLS
9104 LET B$=""
9105 INPUT A$
9106 IF A$="STOP" THEN GO TO 912
0
9107 IF A$="ERROR" THEN GO TO 91
13
9108 PRINT A$
9109 IF LEN A$/32<>INT (LEN A$/3
2) THEN LET A$=A$+" "
9110 IF LEN A$/32<>INT (LEN A$/3
2) THEN GO TO 9109
9111 LET B$=B$+A$
9112 GO TO 9105
9113 PRINT AT 21,0;"ERASE HOW MA
NY LINES?"
9114 INPUT X
9115
9116 CLS
9117 LET B$=B$( TO LEN B$-32*X)
9118 PRINT B$
9119 GO TO 9105
9120 CLS
9121 PRINT AT 10,0;"YOUR COMPLET
E TEXT OR GRAPHIC   CAN BE RECAL
LED BY PRINT B$

9023 STOP
```

■

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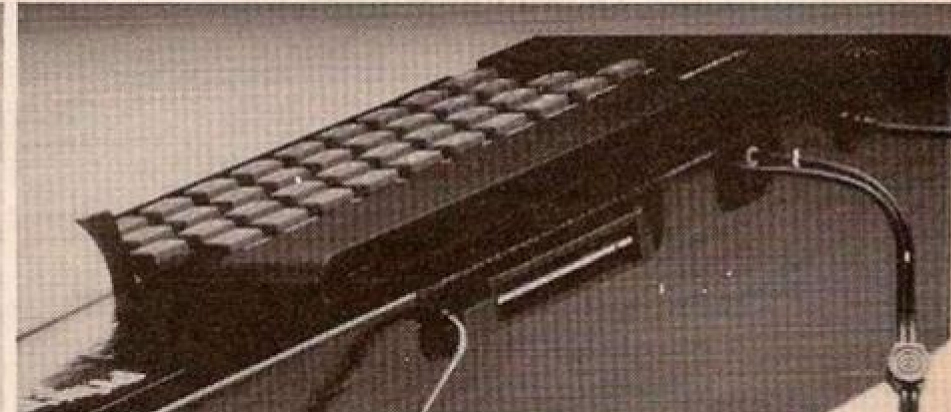
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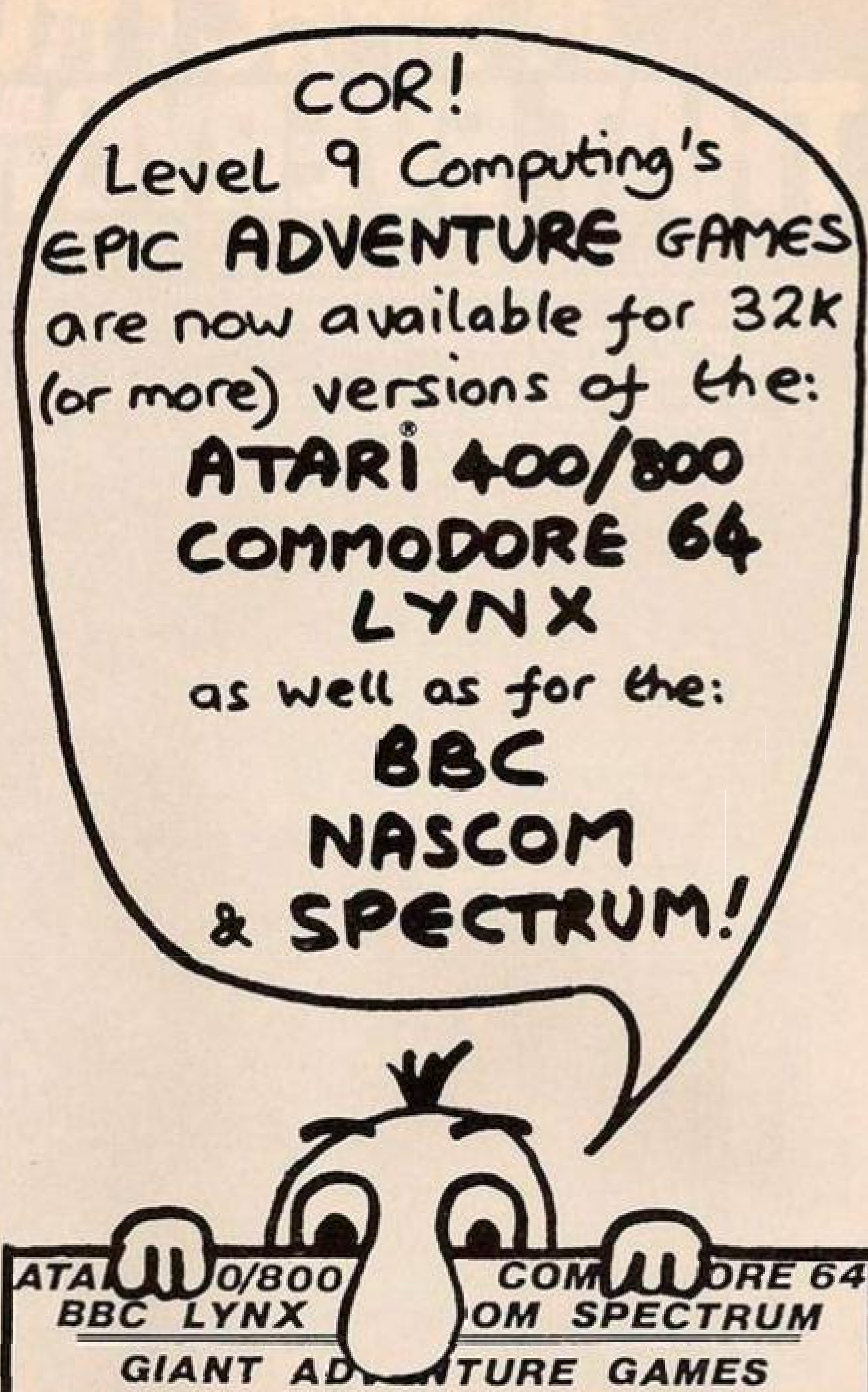
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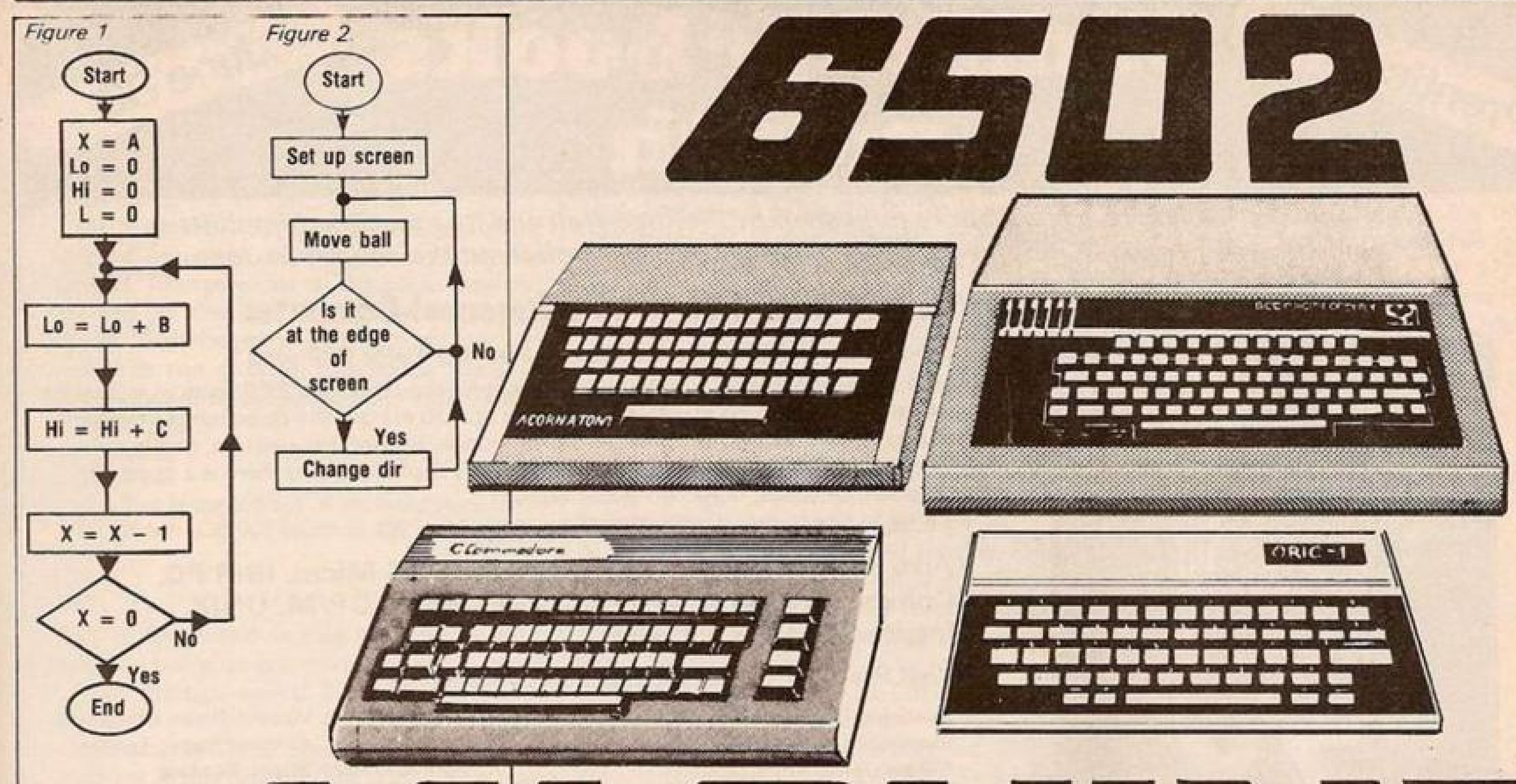
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MACHINE CODE

Darryl Mattocks looks at the compare functions in his series on 6502 code.

Figure 4.

Start
Clear screen
Colour screen
X=6,Y=6,dir=1
Unplot ball
dir=1 Yes X=X+1,Y=Y+1
No
dir=2 Yes X=X+1,Y=Y-1
No
dir=3 Yes X=X-1,Y=Y-1
No
X=X-1,Y=Y+1
Plot ball
Y=0 Yes dir=2
No
Y=20 Yes dir=4
No
X=20 Yes dir=3
No
X=0 Yes dir=1
No

USING VARIOUS BRANCH commands we can find the Basic equivalent of:

```
BEQ — IF A=0 OR A=256 THEN . . .
BNE — IF A<>0 AND A<256 THEN . . .
BPL — IF A<128 THEN . . .
BMI — IF A>=128 THEN . . .
```

But what if we need numbers other than 128 — such as the machine-code equivalent of:

```
IF A<=13 THEN . . .
```

or

```
IF A=57 THEN . . .
```

Obviously using the techniques described so far this is not possible. Consider then the effect of a subroutine in this Basic program.

```
10 INPUT A
20 INPUT B
30 C=1:Z=0
40 D=A-B
41 IF D<0 THEN C=0
42 IF D=0 THEN Z=1
50 IF Z=1 THEN PRINT "A=B":RUN
60 IF C=0 THEN PRINT "A<B":RUN
70 IF C=1 THEN PRINT "A=>B":RUN
80 IF Z=0 THEN PRINT "A<>B":RUN
```

Notice how by first subtracting the A, operations are all now possible using the carry and zero flag jumps — BCS, BEQ, BNE and BCC — already available.

This is what the CMP function does . . . it takes the operand away from the accumulator and sets the N, negative, Z, zero, and C, carry, bits depending on the result which it then discards. The operand and the contents of the accumulator remain unchanged. After a CMP command the following branches can be used:

Branch	detects	Basic equivalent
CMP -> BEQ	A=DATA	IF A=D THEN
CMP -> BNE	A<>DATA	IF A<>D THEN
CMP -> BCS	A>=DATA	IF A>=D THEN
CMP -> BCC	A<DATA	IF A<D THEN
CMP -> BNE -> BCS	A>DATA	IFA>D THEN

In some cases we do not wish to use the accumulator so we have CPX and CPY commands as well. These operate in exactly the same way as the CMP command except that the data is compared with the X and Y registers respectively.

To deal with machine-code For-Next loops we use the immediate mode of addressing to check whether the contents of an ever-increasing register are equal to a set value, such as using the X register and comparing with 15.

Op-code	Mnemonic	Basic
A2 04	LDX #4	10 X=4
8E 05 90	STX 36879	20 POKE 36879,X
E8	INX	30 X=X+1
E0 0F	CPX #15	40 C=1:Z=0:D=X-15
		43 IF D=0 THEN Z=1
		46 IF D<0 THEN C=0
D0 F8	BNE	50 IF Z=0 THEN 20
		55 REM***IF X<15 THEN 20
60	RTS	60 RETURN

All of these could be replaced less literally with

(continued on page 155)

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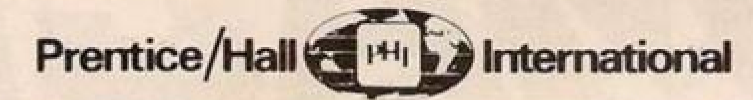
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(continued from page 153)

```
10 FORX=4T015
20 POKE36879,X
30 NEXT
40 END
```

but whereas the Basic version is two lines shorter the machine code is approximately 200 times faster.

We have seen the delay subroutine which counted from 1 to 65,000 in just under two seconds. Compare this to the Basic time and you can get the idea of just how impressive that is. With the processor counting from 1 to 65,000 in two seconds, this means that it is going around the following loop 32,000 times every second.

```
LDX  #255
LDY  #255
DEY  This is carried out at an average once
BNE  every 1/30,000 seconds
DEX
BNE
RTS
```

This is fine when writing to slow down a program, but what of a text editor which needs to scan through several K of text as fast as possible.

In Basic, the speed of each command is not listed but in this program changing line 30 can give us the times for several functions so that we can compare them.

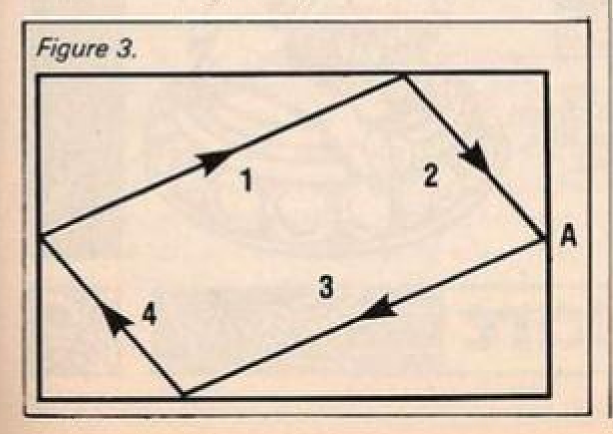
```
10 TI$="000000"
20 FOR I=0 TO 100 STEP 0.01
30 REM Function goes here
40 NEXT
50 PRINT TI$
```

Total time	Average time	Function
40	0.0040	IF I=-5 THEN END
39	0.0039	A=I+2
60	0.0060	A=I/2
290	0.0290	A=SIN(I)
480	0.0480	PRINT I
490	0.0490	A=INVERSE COSH(I)
530	0.0530	A=2↑I

Notice how the speeds vary from 0.0040s. to 0.0530s. It is the same in machine code, some commands are faster than others, but in machine code we can quantify this and say by exactly how much one function is faster than the other. This is because we know how many time cycles each instruction takes.

Every processor executes its commands in the same manner. First it has to fetch. This means: fetch the instruction currently pointed to by the program counter, PC, and store it in a register inside the 6502 chip — the internal register or IR. Then it has to Decode and Execute. The instruction in the IR is now decoded and acted upon. The total time taken for this stage varies depending on the particular instructions, for instance the command NOP, No Operation does not access the RAM or ROM, but LDA ($IE00) Y does and thus takes longer.

Figure 3.



This time is expressed in cycles where 1 cycle is the reciprocal value of the frequency of clock used in the processor.

In the Vic-20 then, assuring the fetch phase is very fast, each cycle is 1/32000 or 904 ns. long, 1 second = 1,000,000,000 nano seconds, the frequency of the internal clock in the Vic-20 is 1.1058 MHz. The LDA #45, for example, take two cycles and thus 1,808 ns. The LDA #45 instruction can be performed approximately 500,000 times per second. It is no wonder then that the decrement and branch sequence of the timing loop can be executed 65,000 times within two seconds.

Having spent hours one week trying to get a particular multiplication program to work and failing dismally, multiplication is my pet hate, so whenever possible I try and avoid it. Every so often, however, there is no escape. This is usually when using X and Y co-ordinates for screen positions and then using the machine code version of:

Address = X + Y * 22 (40 for CBM 64, Pet, etc)

There is a way around the multiplication problem though. When working out 7*5 we are actually evaluating 5+5+5+5+5+5+5 so if we can add in machine code, why not add A to itself B times to achieve A*B.

Let us now try to get the result of multiplying A by B in a simple machine-code program of the form of adding B to itself A times. See figure 1, where C is the carry bit, X is the X register and Lo and Hi are low and high addresses in zero page, such as 00 and 01.

This works but there are two points to watch. As we are using X as a one byte counter, either A or B must be less than 255. The two-byte addition of low and high equals low and high plus seven takes place A times. When A is small — less than 40 — the routine can operate in a few cycles, approximately 0.005 seconds, but as A gets larger, the time needed starts to get significant and a proper multiplication program — we shall cover this next month — should be used.

Program 1 multiplies A and B, where A is stored in location 0, B in location 1 and the result ends up in locations 2 (Lo) and 3 (Hi).

Program 1.

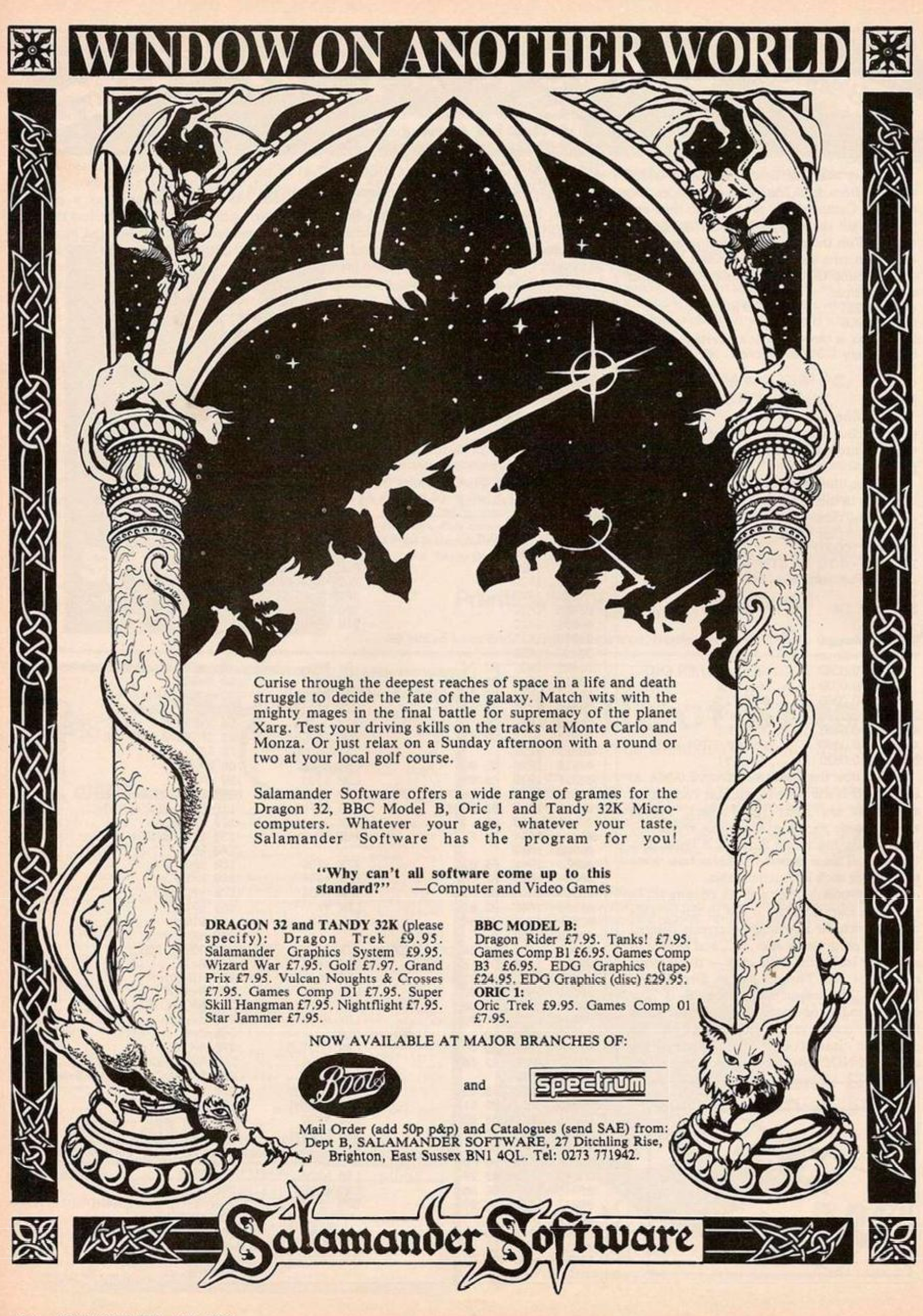
Address	Op-code	Mne-monics	Basic
1A2C	A6 00	LDX $00	10 X = A

(continued on page 157)

Program 2.

```
LOC   CODE                LINE
0000                             *=6700
1A2C                             PLOTLO = $0000
1A2C                             PLOTHI = $0001
1A2C                             XPOS   = $0002
1A2C                             YPOS   = $0003
1A2C                             DIR    = $0004
1A2C                      ;
1A2C                      ;
1A2C  A2 00                      LDX #00          ;10 X=256
1A2E  A9 20                      LDA #$20         ;20 A=32
1A30  9D 00 1E           BRNCH1  STA $1E00,X      ;30 POKE 7680+X,A
1A33  9D 00 1F                   STA $1F00,X      ;40 POKE 7936+X,A
1A36  CA                         DEX              ;50 X=X-1
1A37  D0 F7                      BNE BRNCH1       ;60 IF X<>0 THEN 30
1A39                                              ;70 REM
1A39  A2 00                      LDX #$00         ;80 X=256
1A3B  A9 00                      LDA #$00         ;90 A=1
1A3D  9D 00 96           BRNCH2  STA $9600,X      ;100 POKE 38400+X,A
1A40  9D 00 97                   STA $9700,X      ;110 POKE 38656+X,A
1A43  CA                         DEX              ;120 X=X-1
1A44  D0 F7                      BNE BRNCH2       ;130 IFX<>0THEN 100
1A46                                              ;140 REM
1A46  86 03                      STX YPOS         ;150 YPOS=X
1A48  A2 0F                      LDX #$0F         ;160 X=15
1A4A  86 02                      STX XPOS         ;170 YPOS=X
1A4C  A2 01                      LDX #1           ;180 X=1
1A4E  86 04                      STX DIR          ;190 DIR=X
1A50                                              ;200 REM
1A50  20 E6 1A           LOOP    JSR DELAY        ;205 GOSUB 950
1A53  A9 1E                      LDA #$1E         ;210 A=30
1A55  85 01                      STA PLOTHI       ;220 HIPLOT=A
1A57  A5 02                      LDA XPOS         ;230 A=XPOS
1A59  85 00                      STA PLOTLO       ;240 A=LOPLOT
1A5B  A6 03                      LDX YPOS         ;250 X=YPOS
1A5D  18                 BRNCH3  CLC              ;260 C=0
1A5E  A5 00                      LDA PLOTLO       ;270 A=LOPLOT
1A60  69 16                      ADC #$16         ;280 A=A+C+22
1A62                                              ;285 IF A=>256THENC=1:A=A-256
1A62  85 00                      STA PLOTLO       ;290 LOPLOT=A
1A64  A5 01                      LDA PLOTHI       ;300 A=HIPLOT
1A66  69 00                      ADC #$00         ;310 A=A+C+0
1A68  85 01                      STA PLOTHI       ;320 HIPLOT=A
1A6A  CA                         DEX              ;330 X=X-1
1A6B  D0 F0                      BNE BRNCH3       ;340 IFX<>0THEN260
1A6D  A9 20                      LDA #$20         ;350 A=32
1A6F  A0 00                      LDY #$00         ;360 Y=0
1A71  91 00                      STA (PLOTLO),Y;370 POKE(LOPLOT+256*HIPLOT+Y),A
1A73                                              ;380 REM
1A73  A5 04                      LDA DIR          ;390 A=DIR
1A75  C9 01                      CMP #1           ;400 Z=0:IFA=1THENZ=1
1A77  D0 07                      BNE BRNCH4       ;410 IFZ=0THEN450
```

(listing contined on page 157)



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(continued from page 155)

```
1A2E  A9 00   LDA #0    20 AC = 0
1A30  85 02   STA $02   30 POKE 2, AC
1A32  85 03   STA $03   40 POKE 3, AC
1A34  18      CLC       50 C = 0
1A35  A5 02   LDA $02   60 AC = PEEK
                           (2)
1A37  65 01   ADC $01   70 AC = AC
                           + C +
                           PEEK (1)
                        75 IF AC>255
                           THEN AC =
                           AC - 256:
                           C=1
1A39  85 02   STA $02   80 POKE AC,2
1A3B  A5 03   LDA $03   90 AC = PEEK
                           (3)
1A3D  69 00   ADC #0   100 AC = AC
                           + C
1A3F  85 03   STA $03  110 POKE 3, AC
1A41  CA      DEX      120 X = X - 1
1A42  D0 F0   BNE      130 IF Y <> 0
                           THEN 50
1A44  60      RTS      140 RETURN
```

Line 100 in the loader program for this reads:

```
100 DATA A6,00,A9,00,85,02,85,03,18,A5,02,
    65,01,85,02,A5
105 DATA 03,69,00,85,03,CA,D0,F0,60
```

After running this loader program press New — do not turn off — and try the following program — program 2.

```
10 INPUT "First number" ;A:A=(A and 255):
   POKE 0,A
20 INPUT "Second number" ;B:B=(B and
255):
   POKE 1,B
30 SYS 6700
40 PRINT "A times B =";
50 PRINT PEEK (2) + 256 * PEEK (3)
60 GOTO 10
```

This program just takes all the hard work out of Poking and Peeking and should give the right answer.

Program 2 demonstrates the compare function and the pseudo-multiplication. The main aim of the program is to set a ball bouncing around the screen.

Figure 2 is the generalised flowchart and as we can see, the program is in three distinct sections.

For the ball to appear to bounce, it should move in straight lines, changing direction each time it reaches the edge of the screen. By using X and Y co-ordinates of the position, where X = 0 and Y = 0 at the top left-hand corner of the screen, checking if an edge has been reached is then a simple case of caring X with 0 or 22 and Y with 0 or 21.

The code of directions is:

```
(X = X - 1, Y = Y + 1) 4    top left
1 (X = X + 1, Y = Y + 1)    top right
(X = X - 1, Y = Y - 1) 3    bottom left
2 (X = X + 1, Y = Y - 1)    bottom right
```

The variable Direction can contain any number between 1 and 4 — figure 3.

Here it is handy to remember that theoretically for each edge there is only one direction of the ball with which that edge can be hit, and hence, only one direction with which the ball can leave. Whenever the ball strikes edge A, although its position on edge A may change, it will always strike edge A with the direction 2 and leave with direction 3, so as the ball bounces around the screen, the direction f the ball repeats as 1 -> 2 -> 3 -> 4 -> 1 -> 2 -> 3 -> 4 -> 1 etc. This makes life easier when programming. ■

(listing continued from page 155)

```
1A79  E6 02             INC XPOS        ;420 XPOS=XPOS+1
1A7B  E6 03             INC YPOS        ;430 YPOS=YPOS+1
1A7D  4C 9A 1A          JMP CONT        ;440 GOTO580
1A80  C9 02     BRNCH4  CMP #2          ;450 Z=0:IFA=2THENZ=1
1A82  D0 07             BNE BRNCH5      ;460 IFZ=0THEN500
1A84  E6 02             INC XPOS        ;470 XPOS=XPOS+1
1A86  C6 03             DEC YPOS        ;480 YPOS=YPOS-1
1A88  4C 9A 1A          JMP CONT        ;490 GOTO580
1A8B  C9 03     BRNCH5  CMP #3          ;500 Z=0:IFA=3THENZ=1
1A8D  D0 07             BNE BRNCH6      ;510 IFZ=0THEN550
1A8F  C6 02             DEC XPOS        ;520 YPOS=YPOS-1
1A91  C6 03             DEC YPOS        ;530 XPOS=XPOS-1
1A93  4C 9A 1A          JMP CONT        ;540 GOTO580
1A96  C6 02     BRNCH6  DEC XPOS        ;550 XPOS=XPOS-1
1A98  E6 03             INC YPOS        ;560 YPOS=YPOS+1
1A9A                                    ;570 REM
1A9A  A9 1E     CONT    LDA #$1E        ;580 A=30
1A9C  85 01             STA PLOTHI      ;590 HIPLOT=A
1A9E  A5 02             LDA XPOS        ;600 A=XPOS
1AA0  85 00             STA PLOTLO      ;610 LOPLOT=A
1AA2  A6 03             LDX YPOS        ;620 X=YPOS
1AA4  18        BRNCH7  CLC             ;630 C=0
1AA5  A5 00             LDA PLOTLO      ;640 A=LOPLOT
1AA7  69 16             ADC #$16        ;650 A=A+C+22:IFA>=256THENA=A-25
6:C=1
1AA9  85 00             STA PLOTLO      ;660 LOPLOT=A
1AAB  A5 01             LDA PLOTHI      ;670 A=HIPLOT
1AAD  69 00             ADC #$00        ;680 A=A+C+0
1AAF  85 01             STA PLOTHI      ;690 HIPLOT=A
1AB1  CA                DEX             ;693 X=X-1
1AB2  D0 F0             BNE BRNCH7      ;696 IFX<>0THEN630
1AB4  A0 00             LDY #$00        ;700 Y=0
1AB6  A9 51             LDA #$51        ;710 A=81
1AB8  91 00             STA (PLOTLO),Y  ;720 POKE(LOPLOT+256*HIPLOT+Y),A
1ABA                                    ;730 REM
1ABA  A5 02             LDA XPOS        ;740 A=XPOS
1ABC  D0 07             BNE BRNCH8      ;750 IFA<>0THEN790
1ABE  A9 02             LDA #$02        ;760 A=1
1AC0  85 04             STA DIR         ;770 DIR=A
1AC2  4C 50 1A          JMP LOOP        ;780 GOTO150
1AC5  C9 14     BRNCH8  CMP #$14        ;790 Z=0:IFA=21THENZ=1
1AC7  D0 07             BNE BRNCH9      ;800 IFZ=0THEN840
1AC9  A9 04             LDA #$04        ;810 A=2
1ACB  85 04             STA DIR         ;820 DIR=A
1ACD  4C 50 1A          JMP LOOP        ;830 GOTO150
1AD0  A5 03     BRNCH9  LDA YPOS        ;840 A=YPOS
1AD2  D0 07             BNE BRNCHA      ;850 IFA<>0THEN890
1AD4  A9 01             LDA #$01        ;860 A=4
1AD6  85 04             STA DIR         ;870 DIR=A
1AD8  4C 50 1A          JMP LOOP        ;880 GOTO150
1ADB  C9 14     BRNCHA  CMP #$14        ;890 Z=0:IFA=22THENZ=1
1ADD  D0 04             BNE BRNCHB      ;900 IFZ=0THEN930
1ADF  A9 03             LDA #$03        ;910 A=2
1AE1  85 04             STA DIR         ;920 DIR=A
1AE3  4C 50 1A  BRNCHB  JMP LOOP        ;930 GOTO150
1AE6                                    ;940 REM DELAY
1AE6  A2 2F     DELAY   LDX #$2F        ;950 REM SEE
1AE8  A0 7F     BRNCHC  LDY #$7F        ;960 REM PREVIOUS
1AEA  88        BRNCHD  DEY             ;970 REM ISSUES
1AEB  D0 FD             BNE BRNCHD      ;980 REM
1AED  CA                DEX             ;990 REM
1AEE  D0 F8             BNE BRNCHC      ;1000 REM
1AF0  60                RTS             ;1010 RETURN
1AF1            ;
1AF1            ;
1AF1            ;
1AF1                    .END
SYMBOL TABLE
SYMBOL VALUE
 BRNCH1  1A30   BRNCH2  1A3D   BRNCH3  1A5D   BRNCH4  1A80
 BRNCH5  1A8B   BRNCH6  1A96   BRNCH7  1AA4   BRNCH8  1AC5
 BRNCH9  1AD0   BRNCHA  1ADB   BRNCHB  1AE3   BRNCHC  1AE8
 BRNCHD  1AEA   CONT    1A9A   DELAY   1AE6   DIR     0004
 LOOP    1A50   PLOTHI  0001   PLOTLO  0000   XPOS    0002
 YPOS    0003

100 DATA a2,00,a9,20,9d,00,1e,9d,00,1f,ca,d0,f7,a2,00,a9,00,9d,00,96,9d
110 DATA 9d,00,97,ca,90,f7,86,03,a2,0f,86,02,a2,01,86,04,20,e6,1a,a9,1e
120 DATA 85,01,a5,02,85,00,a6,03,18,a5,00,69,16,85,00,a5,01,69,00,85,01
130 DATA CA,d0,f0,a9,20,a0,00,91,00,a5,04,c9,01,d0,07,e6,02,e6,03,4c,9a
140 DATA 1a,c9,02,d0,07,e6,02,c6,03,4c,9a,1a,c9,03,d0,07,c6,02,c6,03,4c
150 DATA 9a,1a,c6,02,e6,03,a9,1e,85,01,a5,02,85,00,a6,03,18,a5,00,69,16
160 DATA 85,00,a5,01,69,00,85,01,ca,d0,f0,a0,00,a9,51,91,00,a5,02,d0,07
170 DATA a9,02,85,04,4c,50,1a,c9,14,d0,07,a9,04,85,04,4c,50,1a,a5,03,d0
180 DATA 07,a9,01,85,04,4c,50,1a,c9,14,d0,04,a9,03,85,04,4c,50,1a,a2,2f
190 DATA a0,7f,88,d0,fd,ca,d0,f8,60
```

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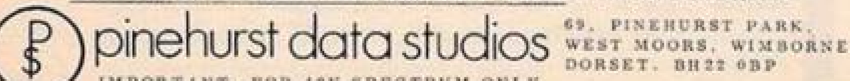
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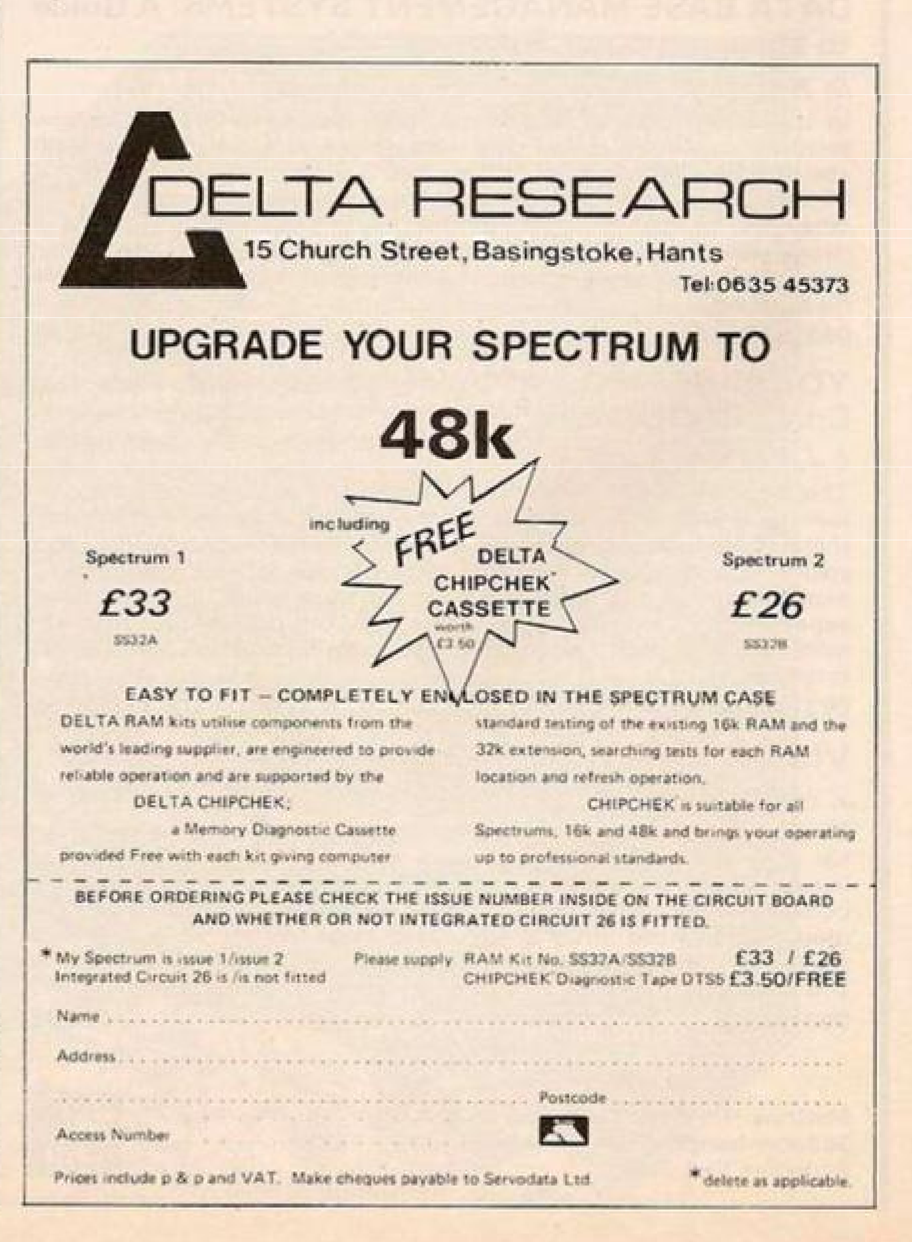
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RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

ZX CONVERSION

I have just purchased a 16K ZX-81, and would like to know if it is possible to convert Spectrum programs for use on it. I am particularly interested in the Flight Simulator featured in your December 1982 issue.

Brendan J Fischer,
Kanagawa-ken,
Japan.

IN GENERAL, you cannot easily convert Spectrum programs containing any machine code to the ZX-81. Programs in Basic, which do not use Peek and Poke can be converted, after a fashion, although the ZX-81 version may well run — if it is a moving graphics program — too slowly to be satisfactory. You need to know exactly what the Spectrum program does, so that you will know how to substitute for such things as Screen$ and Attr. If you have just started programming your ZX-81, I would suggest you begin such conversions with short, text-only output programs.

CODE ADVICE

Last year I purchased a Dragon 32 home computer and I am very happy with its Basic facilities and graphics. Now I feel that I have gone as far as I can in this language. The most obvious next step seems to be machine code — a subject that I know very little about. I have read several advertisements in *Your Computer* for Dragon machine-code aids, such as the package offered by J Morrison Software. This is where the problem arises — I have no idea what I should be looking for. For example what do I need from an editor, or an assembler, monitor, and disassembler. Can you advise me? Would I be better off buying a ROM cartridge or a cassette-tape version?

S Murray,
Yarm,
Cleveland.

PROBABLY THE most useful item on your list would be an assembler. By allowing you to enter a program in assembly language mnemonics, rather than as a series of numeric instructions, an assembler makes writing a machine-code program much easier. It also enables you to use labels and so saves you from the tedious business of keeping track of addresses and calculating relative jumps. A good assembler should also have an editor which will permit you to insert and delete program lines in the same way as you can edit a Basic program. The term editor is sometimes used in the same sense as the term monitor. As such it offers a range of functions which are useful in testing and debugging a program. These include facilities for displaying a block of memory, moving sections of code, and testing subroutines within a program. A disassembler simply translates machine code into assembly language. You might want to use one to examine the Operating System or other people's code. Ideally you could do with all these facilities but I would advise you at least to buy an assembler. For a monitor and disassembler you need go no further than key in the two programs printed in *Your Computer* for May of this year. There is no reason why a program on tape should not be as powerful as one on cartridge. A program in a ROM cartridge, however, has the advantage of being instantly available.

INCOMPATIBILITY

Using my W H Smith computer-compatible cassette recorder with my ZX-81, I am able to Save and Reload my own programs. However, I cannot load either home-made or commercial programs containing an Autorun. Could you please advise how to overcome this?

D K Newby,
Teignmouth,
Devon,

THIS IS AN odd problem. The only thing I can think of which could cause this would be programs which save the Display file along with the program. This means a 1K program which was saved with a 16K RAM pack in place may well be 3.25K long — including the display file — and thus will not reload into a 1K machine. I assume you are correctly autosaving using the second to last line of your program as

SAVE "NAME"

and the final line as Run, then Saving the program by entering Goto as second to last line number.

TEACH AND PLAY

In the near future I will be purchasing a computer. The two that interest me the most are the BBC model B and the Atari 800. Please can you advise me which you consider is the best choice for education and games needs.

Sunjoy Basu,
Coventry,
Warwickshire.

THE AVAILABLE software will really control your decision as to which computer you buy. Whereas the BBC machine is well supported with games and educational software, the Atari software is almost exclusively extremely good games. You will have to decide which need is paramount, and if you are not going to be writing all your own programs, let this need determine which machine you should buy.

LEARNING CODE

I have heard that machine code is much better than Basic for producing speedy programs on the Spectrum. However, I am finding it very difficult to make sense of a book on the subject I bought. Is there a simple way to learn machine code . . . or at least a way to learn enough to be able to program some machine code into my Spectrum games?

Sandy Grant,
Fareham,
Hampshire.

A PRODUCT which may help you is called *Machine-code Test Tool* which is available from most bookshops. The product consists of a cassette and a little, 32-page booklet which explains how to use the program in order to give you practical examples, and hands-on experience of using machine code. Using this program, you can enter and test your own machine-code programs, as well as examine the Spectrum ROM. If you follow this booklet through carefully and carry out all the examples, you should be in a much stronger position to use machine code. MCTT is manufactured by Oxford Computer Publishing Ltd.

U.S. TRANSLATION

I should be grateful if you could tell me whether a program recorded on a ZX-81 or Spectrum in Britain could be sent to the United States and work without modification on the corresponding machine.

J S Coombes,
Coventry,
Warwickshire.

CERTAINLY THEY CAN. The Load and Save aspects of the Sinclair computers have not been changed for the US, although the modulator to produce the television picture has, of course, been altered. The only fundamental difference between the computers here and there is that the TS-1000 — the US name for the ZX-81 — has 2K on board, rather than 1K of RAM as here; the TS-1500 has 16K on board; it is, I have been told, basically a 16K ZX-81 with a Spectrum-like keyboard; and the TS-82000 — the US Spectrum — will have some slightly different commands from the Spectrum. These are unlikely to affect your work. Full details of the TS-2000 keyboard were not available when we went to press.

ROM LINK

I am thinking of buying a 4K graphics ROM for my ZX-81 and I am hoping that you can tell me more about it to set my mind at rest. Could you please tell me how it is connected to the computer and how the graphics are used in programs?

M Harvey,
Harlow,
Essex.

THE 4K ROM from Kayde takes about a quarter of an hour to fit, and needs a fine-tipped soldering iron. The ROM comes with five sheets of fitting instructions. There are eight sets of graphics, which are accessed by a single machine code call — such as

LET L = USR . . . or RAND USR . . .

The graphic sets are Sinclair graphics, faces and bodies, space invaders, upper and lower case text, Pac-Man graphics, asteroids, planes and miscellaneous. Adding a 2K RAM chip gives you access to four more sets of the graphics. Several programs have been written for use with the graphics ROM.

EXPERIMENTATION

I am experimenting with the machine-Code routines on my 16K ZX-81, my problem is as follows: I wish to use two or more short machine-code routines within a Basic program. For the sake of this discussion let us presume that each routine is 20 bytes long and I wish to use two of them. I created a Rem statement 40 characters long and Poked both routines in one after the other, calling the first with Usr 16514 and the second with Usr 16534. The result was a crash. My next attempt was to use two Rem statements in different parts of the Basic program, this failed as I could find no way of Poking into the second Rem — or the first if it was not line 1. Can you please help?

Derek Harris,
Lower Wick,
Worcester.

IT CERTAINLY is possible to store two or more machine-code routines in the same Rem statement or in consecutive Rem statements. I imagine there must be an error in one of your routines. Possibly you have forgotten to end each routine with a RTS (96) instruction.

Another possibility if you are using two Rem statements is that you have not calculated correctly the start of the first free location in the second statement. Remember that the line number and Rem token take up five bytes at the start of the line; and there should also be a Newline character (118) at the end of the line. If, for example, the first Rem statement contains ten characters the address of the first free location in the second statement is 16530. ■

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(J) = Joysticks Required.

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Reversi

R M Francis, Brentwood, Essex.



WRITTEN FOR A 16K machine to provide a game which is very fast when the computer is choosing its move, this is also proof against an incorrect entry by the person playing. The speed has been achieved by a machine-code routine and the error prevention by a considerable degree of checking by the Basic program.

In addition there are two levels of play available; at the lower level the computer merely maximises the number of its opponent's positions which it captures; at the higher level it also considers the relative merits of the position which it will occupy with its own move.

The structure of the Basic program is as follows:

- 20 subroutine to convert the current board positions to an address table for use by the machine-code routine
- 30-120 subroutine to update current positions when a move has been selected
- 130-320 subroutine to print board with current positions
- 330-370 subroutine to initialise start positions
- 380-520 introduction and initialisation
- 530-630 computer's move including call for machine-code program
- 640-800 player's move including checks on legality
- 810-910 print result of game and restart if required

This should be entered first and saved on tape using the self-start facility, the command should be

SAVE "Reversi" LINE 10

When this has been Verified the computer should be Newed and the command

CLEAR 31999

entered. The 465 bytes of machine code should be entered using the following program:

```
10 LET s=0
20 FOR n=32111 TO 32575
30 INPUT b
40 POKE n,b
50 LET s=s+b
60 PRINT n; TAB 10;b; TAB 20;s
70 NEXT n
```

The purpose of lines 10 and 50 is to provide a sumcheck of the machine-code entry; when all the machine code has been entered the sumcheck total should be 56695. To ensure that you are on the right track the intermediate checks are as follows:

After the byte for address 32200 has been entered the total should be 11300 and after 32300 has been entered the total should be 25851. After 32400, the total should be 35956, and after 32500, the total should be 47032.

When this has been entered, and the sumcheck found to be correct then save it after the Basic program with the command

SAVE "mcode"CODE 32111,465

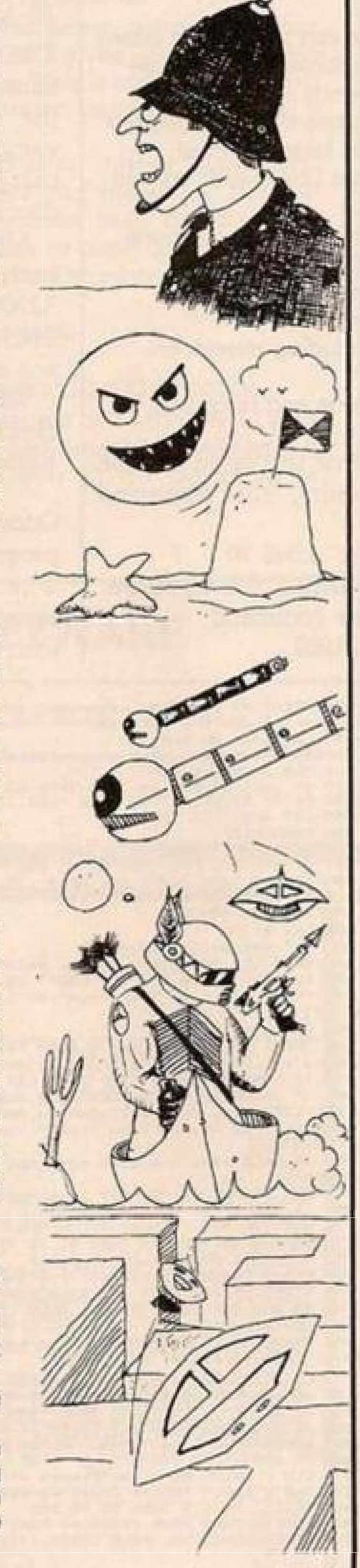
Once this has been Verified the whole program can be loaded from the beginning. The self-starting Basic program will automatically load the machine code. From then on everything should be self-explanatory.

```
  1 LPRINT CHR$ (5);CHR$ (27);CHR$ (33);CHR$ (8);CHR$ (4);
  2 STOP
 10 GO TO 380
 20 FOR b=1 TO 10: FOR c=1 TO 10: POKE (32000+(b-1)*10+c),a(b,c): NEXT c: NEXT
b: RETURN
 30 FOR b=-1 TO 1
 40 FOR c=-1 TO 1
 50 LET d=m: LET e=n
 60 IF a(d+b,e+c)<>s THEN GO TO 80
 70 LET d=d+b: LET e=e+c: GO TO 60
 80 IF a(d+b,e+c)<>t THEN GO TO 120
 90 IF a(d,e)=s THEN LET j=j+1
100 LET a(d,e)=t: IF m=d AND n=e THEN GO TO 120
110 LET d=d-b: LET e=e-c: GO TO 90
120 NEXT c: NEXT b: RETURN
130 PRINT AT 0,12;"REVERSI"
140 PRINT AT 2,0;"I'm playing 'x' - "
150 PRINT TAB 14;"you're playing 'o'"
160 LET z=4
170 LET g=0: LET h=0
180 PRINT AT (z+1),19;" 12345678 "
190 FOR b=2 TO 9: PRINT AT (b+z),19;CHR$ (b+95);
200 FOR c=2 TO 9
210 IF a(b,c)=x THEN PRINT "x";
220 IF a(b,c)=o THEN PRINT "o";
230 IF a(b,c)=f THEN PRINT ".";
240 IF a(b,c)=x THEN LET g=g+1
250 IF a(b,c)=o THEN LET h=h+1
260 NEXT c
270 PRINT CHR$ (b+95)
280 NEXT b
290 PRINT AT (z+10),19;" 12345678 "
300 IF g+h=64 THEN GO TO 810
310 PRINT : PRINT TAB 5;"I have ";g;": you have ";h;".    "
320 RETURN
330 FOR b=1 TO 10: FOR c=1 TO 10
340 IF b<>1 AND c<>1 AND b<>10 AND c<>10 THEN LET a(b,c)=f
350 NEXT c: NEXT b
360 LET a(5,5)=x: LET a(6,6)=x: LET a(6,5)=o: LET a(5,6)=o
370 RETURN
380 CLEAR 31999: POKE 23609,75: LOAD ""CODE : CLS
390 PRINT AT 11,0; FLASH 1;"Don't forget to stop the tape"
400 DIM a(10,10): LET z$="                              ": LET f=46: LET j=0: LET k=48: LET o
=111: LET r=0: LET u=57: LET v=k+k: LET w=k+u: LET x=120
410 PRINT AT 20,0;"Press any key to start": IF INKEY$="" THEN GO TO 410
420 CLS : PRINT AT 11,0;"Please wait a moment": GO SUB 330: GO SUB 20
430 CLS : PRINT AT 10,3;"In this game of 'REVERSI'     there are two levels of p
lay.";AT 13,3;"Do you want to play the       easier game (ENTER 1) or the     hard
er one (ENTER 2)?"
440 INPUT l: IF l<1 OR l>2 THEN GO TO 440
450 IF l=1 THEN POKE 32528,0: POKE 32529,0: POKE 32530,0: GO TO 470
460 POKE 32528,205: POKE 32529,173: POKE 32530,125
470 CLS : PRINT AT 0,12;"REVERSI"
480 PRINT AT 2,2;"You make your move by enteringthe letter down the side and th
enumber across the top, for       example: 'd4' or 'b8'"
490 LET z=6: GO SUB 170
500 INPUT "Do you want to go first?          (Y or N) ";q$
510 CLS : GO SUB 130
520 IF q$<>"n" AND q$<>"N" THEN GO TO 640
530 PRINT AT 10,4;" My move ";AT 12,0;z$;AT 13,0;z$
540 LET s=o: LET t=x
550 RANDOMIZE
560 LET i=USR 32445
570 IF i=0 AND r=0 THEN GO TO 810
580 IF i=0 THEN PAUSE 50: BEEP .25,25: BEEP .25,20: PRINT AT 10,5;"I can't";AT
11,5;"go": PAUSE 75: GO TO 640
590 LET i=i-32000
600 LET m=INT (i/10)
610 LET n=i-m*10: LET m=m+1
620 BEEP .25,25: BEEP .25,20: PRINT AT (4+m),(n+18); FLASH 1;"x"
630 GO SUB 30: GO SUB 20: BEEP .25,25: BEEP .25,15: GO SUB 160
640 PRINT AT 10,4;"Your move";AT 11,0;z$;AT 12,1;"If you can't go";AT 13,4;"ent
er 'z9'"
650 LET s=x: LET t=o
660 INPUT p$: IF LEN p$<>2 THEN PRINT AT 19,0; FLASH 1;"You're move should be m
ade by"; FLASH 0;"    "; FLASH 1;"entering 2 characters not ";LEN p$: GO TO 660
670 IF p$="z9" OR p$="9z" THEN LET r=0: GO TO 750
680 IF (CODE p$>v AND CODE p$<w AND p$(2)>CHR$ k AND p$(2)<CHR$ u) OR (CODE p$>
k AND CODE p$<u AND p$(2)>CHR$ v AND p$(2)<CHR$ w) THEN GO TO 700
690 PRINT AT 19,0; FLASH 1;p$;" isn't on the board; try again": PRINT z$;z$: GO
TO 660
700 IF CODE p$>k AND CODE p$<u AND p$(2)>CHR$ v AND p$(2)<CHR$ w THEN LET p$=p$
(2)+p$(1)
710 LET m=CODE p$-95: LET n=VAL p$(2)+1: LET r=(m-1)*10+n-1
720 IF a(m,n)<>f THEN GO TO 800
730 LET j=0
740 GO SUB 30: IF j<1 THEN GO TO 790
750 PRINT AT 19,0; FLASH 0;z$;z$
760 PRINT FLASH 0;z$;z$: IF r=0 THEN GO TO 530
770 BEEP .25,25: BEEP .25,20: PRINT AT (4+m),(n+18); FLASH 1;"o"
780 GO SUB 20: BEEP .25,25: BEEP .25,15: GO SUB 160: GO TO 530
790 LET a(m,n)=f
800 PRINT AT 19,0; FLASH 1;"You cannot go at ";p$;"; try again"; FLASH 0;"   ":
PRINT FLASH 0;z$;z$: GO TO 660
810 PRINT AT 10,0;z$;AT 12,0;z$;AT 13,0;z$;AT 16,0;z$;z$
820 IF g>h THEN PRINT AT 18,0;"I won, ";g;" - ";h
830 IF g<h THEN PRINT AT 18,0;"You won, ";h;" - ";g
840 IF g=h THEN PRINT AT 18,0;"It's a draw: ";g;" - ";h
850 INPUT "Would you like another game?    (Y or N) ";y$
860 IF y$="n" OR y$="N" THEN STOP
870 CLS : PRINT AT 11,0;"Please wait a moment": GO SUB 330: GO SUB 20
880 CLS : INPUT "Which level do you want to play (1 or 2)? ";l
890 IF l<1 OR l>2 THEN GO TO 880
900 IF l=1 THEN POKE 32528,0: POKE 32529,0: POKE 32530,0: GO TO 500
910 POKE 32528,205: POKE 32529,173: POKE 32530,125: GO TO 500
```

32111	62	50	190	208	62	32191	202	134	126	254	87	32271	202	142	126	254	88
32116	115	190	56	8	58	32196	202	142	126	254	86	32276	40	126	254	83	40
32121	107	125	60	50	107	32201	202	142	126	254	85	32281	122	254	79	40	118
32126	125	201	58	106	125	32206	202	142	126	254	84	32286	254	78	40	114	254
32131	33	107	125	134	50	32211	202	142	126	254	69	32291	77	40	110	254	76
32136	106	125	201	62	0	32216	202	142	126	254	62	32296	40	106	254	75	40
32141	50	107	125	125	145	32221	202	142	126	254	59	32301	102	254	74	40	98
32146	111	205	111	125	62	32226	202	142	126	254	52	32306	254	73	40	94	254
32151	111	190	40	245	201	32231	202	142	126	254	49	32311	72	40	90	254	68
32156	62	0	50	107	125	32236	202	142	126	254	42	32316	40	86	254	63	40
32161	125	129	111	205	111	32241	202	142	126	254	39	32321	82	254	58	40	78
32166	125	62	111	190	40	32246	202	142	126	254	32	32326	254	53	40	74	254
32171	245	201	125	254	89	32251	202	142	126	254	17	32331	48	40	70	254	43
32176	202	134	126	254	82	32256	202	142	126	254	16	32336	40	66	254	38	40
32181	202	134	126	254	19	32261	202	142	126	254	15	32341	62	254	33	40	58
32186	202	134	126	254	12	32266	202	142	126	254	14						

(continued on page 165)

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(continued from page 163)

32346	254	29	40	54	254
32351	28	40	50	254	27
32356	40	46	254	26	40
32361	42	254	25	40	38
32366	254	24	40	34	254
32371	23	40	30	254	22
32376	40	26	254	18	40
32381	22	254	13	40	18
32386	58	106	125	201	58
32391	106	125	203	39	203
32396	39	201	58	106	125
32401	203	39	201	58	106
32406	125	60	203	47	201
32411	237	75	118	92	205
32416	43	45	239	161	15
32421	52	55	22	4	52
32426	128	65	0	0	128
32431	50	2	161	3	49
32436	56	205	162	45	237
32441	67	118	92	201	62
32446	0	50	105	125	50
32451	108	125	50	109	125
32456	6	78	33	11	125
32461	120	133	111	62	46
32466	190	32	100	229	62
32471	0	50	106	125	14
32476	11	205	139	125	225
32481	229	205	156	125	225
32486	229	13	205	139	125
32491	225	229	205	156	125
32496	225	229	13	205	139
32501	125	225	229	205	156
32506	125	225	229	14	1
32511	205	139	125	225	229
32516	205	156	125	225	229
32521	58	106	125	254	0
32526	40	40	0	0	0
32531	33	105	125	190	56
32536	31	32	17	245	197
32541	229	205	155	126	33
32546	0	78	167	237	66
32551	56	12	225	193	241
32556	50	105	125	225	34
32561	108	125	24	4	225
32566	193	241	225	16	143
32571	237	75	108	125	201

Drawing program

Christopher Stops,
Bridgwater,
Somerset.

ZX-81

HERE IS A drawing program for the 1K ZX-81. Because the program is in compact machine code, almost the whole screen is available. It is not necessary for me to write all the usual advice and directions such as the machine code loader program. Here is some information you will require: type in line 10 as a Rem statement followed by 126 Xs. Then you must use a hexadecimal loader to enter the code in to the hex listing. Line 0 should be 20 Rand Usr 16514. The controls are 1 left, 2 down, 3 up, 4 right, 5 to change printer character, Shift to stop the program. The background shade is set at 16527 — set as 0, or a white background. As the program stands the whole character set is available, but if one requires the graphics symbols only, just

POKE 16595,11

and

POKE 16601,139

Because of the way the code works, to move south-east, just press 2 and 4 together that is down and right. To erase, select the same print character as the background. This also applies to moving the cursor. The cursor's position is always clear because it is printed as an X for a fraction of second each time the program goes round. Do not print an asterisk unless you are sure you want it there, because these mark the border and are erasable. The border is marked to stop someone printing over the Newline characters and crashing the program.

ZX-81 drawing program

16514	3E	17	06	20	D7
16519	10	FD	0E	12	D7
16524	06	1E	3E	00	D7
16529	10	FD	3E	17	D7
16534	0D	20	F2	06	20
16539	D7	10	FD	2A	0C
16544	40	11	23	00	19
16549	E5	CD	B8	02	7C
16554	E1	44	4D	CB	47
16559	C8	11	21	00	CB
16564	4F	20	01	2B	CB
16569	57	20	01	19	C8
16574	5F	20	04	C6	00
16579	ED	52	CB	67	20
16584	01	23	CB	6F	20
16589	13	3A	21	40	3C
16594	FE	40	20	02	3E
16599	80	FE	C0	20	02
16604	3E	00	32	21	40
16609	7E	FE	17	20	02
16614	60	69	36	3D	01
16619	00	05	0B	78	B1
16624	20	FB	3A	21	40
16629	77	01	00	10	08
16634	78	B1	20	FB	18
16639	A5	76	00	14	2D

Data Base

M Maynard,
Edinburgh.

BBC

DATA BASES are used a lot, especially in business, but for a full system disc drives are essential. This program I have written contains many of the facilities of a professional system, except it is designed for a BBC Micro with cassette and a printer.

The program will run on a BBC computer model B. It will just run on a model A, but to make any use of it you would have to use mode 7. This has no real disadvantage — I just prefer mode 6. The program uses about 7K, with screen memory of 8K. You can set up new file or add to existing file. This option can be used to create a new file or add to a file in memory. The computer asks you if you want to set up a new file. If you answer yes it warns you that any file already in memory will be erased. If you opt to continue you are asked for the approximate number of items in the file. The computer will then add an extra 10 percent, in case you underestimate. The next stage is to input the data. The information will always be sorted with the first letter most significant — this should be borne in mind if a page number is part of the entry. To finish enter

"$$$"

and this will return you to the menu. If you want to add to an existing file it checks space and then tells you the maximum number of items you can add. You then proceed as you would if you created a new file.

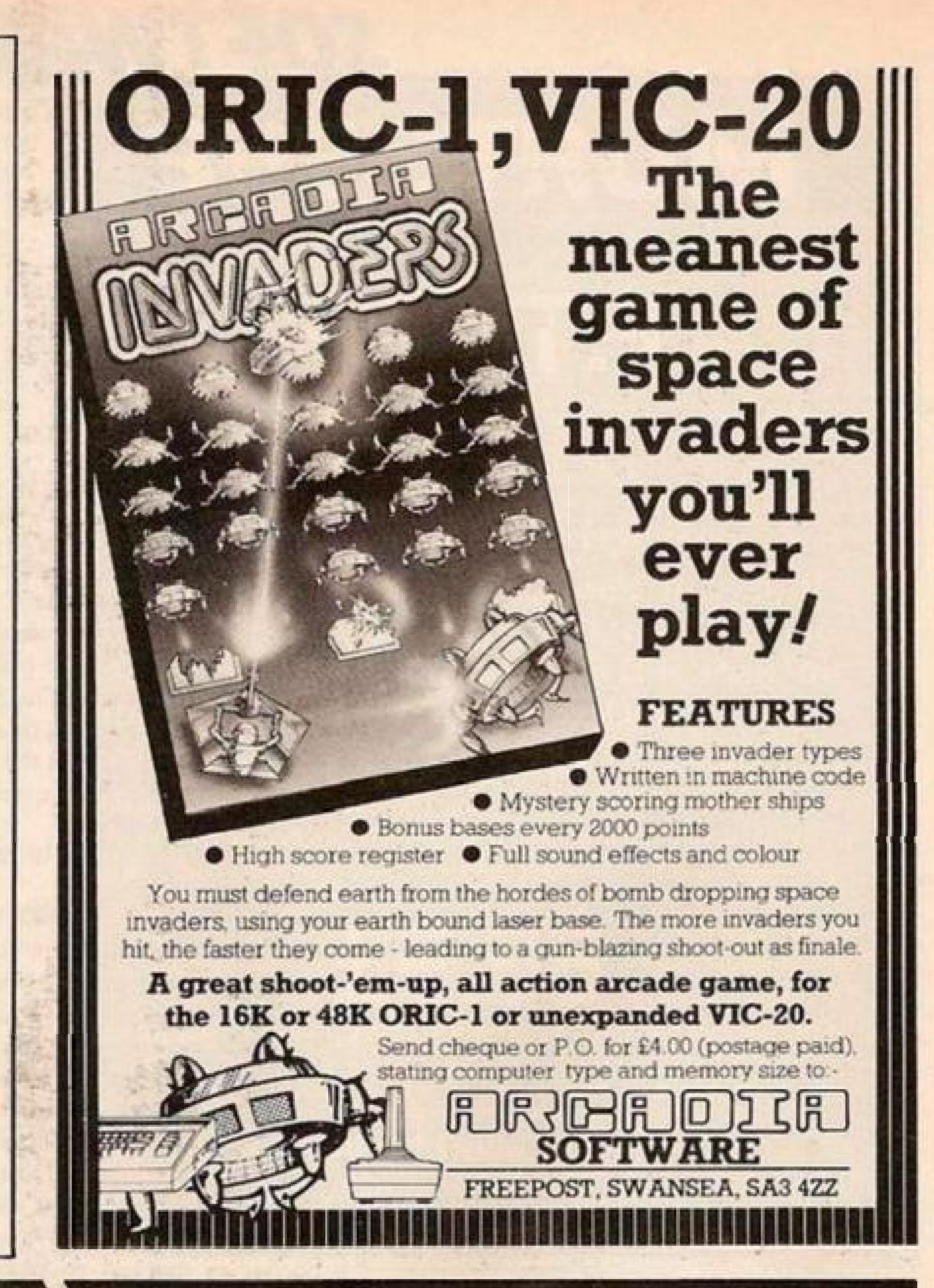
The Check file memory option allows you to check each of the entries and then, if they are wrong to alter, or delete them. The computer

(continued on page 167)

BBC data program

```
   10 ON ERROR IF ERR=17 GOTO 30 ELSE REPORT:PRINT" at line ";ERL:END
   20 REM **** DATA BASE SYSTEM ****
   30 MODE6
   40 PRINT TAB(10,2)"MASTERFILE";TAB(10,3);STRING$(10,"-")
   50 PRINT''"OPTIONS:"
   60 PRINT"1)....Set up new file/add to old file."
   70 PRINT"2)....Check file in memory."
   80 PRINT"3)....Set up Printer."
   90 PRINT"4)....Sort file in memory."
  100 PRINT"5)....Print file."
  110 PRINT"6)....Load file from tape."
  120 PRINT"7)....Save file to tape."
  130 PRINT"8)....Find an item in the file."
  140 PRINT"9)....End Program."
  150 PRINT''"Enter option:";
  160 OP%=VAL(GET$):IF OP%=0 PRINT'"INPUT ERROR!"'"Hit any key to continue...";:
WAIT$=GET$:GOTO 30
  170ON OP% GOSUB 190,540,730,870,1090,1260,1490,1640,1840
  180 GOTO 30:REM RE-PRINT MENU AFTER OPTION
  190 REM ***** SET UP NEW FILE/ADD TO OLD *******
  200 CLS:PRINTTAB(7,2)"SET UP OR ADD TO FILE"TAB(7,3)STRING$(21,"-")
  210 PRINT''"New file (Y/N)?";:IN$=GET$
  220 IF IN$="N" THEN 410 ELSE IF IN$<>"Y" THEN PRINT''"INPUT ERROR!!"'"Hit any
key to continue......";:WAIT$=GET$:GOTO 200
  230 PRINT''"You will erase the file currently in"'"memory-do you wish to do th
is (Y/N)?";:IN$=GET$
  240 IF IN$<>"Y" THEN 30
  250 CLS:PRINT TAB(6,2)"SET UP NEW FILE"TAB(6,3)STRING$(15,"-")
  260 CLEAR
  270 INPUT''"File name:"NM$
  280 IF LEN(NM$)<1 OR LEN(NM$)>10 THEN PRINT'"ILLEGAL NAME!!"''"Press any key t
o continue..";:WAIT$=GET$:GOTO 250
  290 INPUT"Approximate number of items in file:",NO
  300 IF NO<1 THEN PRINT"INPUT ERROR!!!"'"Hit any key to continue...";:WAIT$=GET
$:GOTO 290
  310 NO=NO+(NO/10):REM ALLOW 10% INACCURACY
  320 DIM DT$(NO):LGTH=0
  330 PRINT''"Input items in file:"'"Remember that thefile will be sorted"'"with
 the first letter most significant."'"Enter '$$$' to finish."
  340 REPEAT
  350 INPUTLINE"Item:"IN$
  360 IF IN$<>"$$$" THEN LGTH=LGTH+1:DT$(LGTH)=IN$
  370 UNTIL IN$="$$$" OR LGTH=NO
  380 PRINT'''"END:Check data (enter 'Y' or 'N')";:IN$=GET$
  390 IF IN$="Y" THEN GOSUB 540
  400 GOTO 180
  410 REM ***** ADD ITEMS *****
  420 CLS:PRINT TAB(10,2)"ADD MORE ITEMS"TAB(10,3)STRING$(14,"-")
```

(listing continued on page 167)



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(continued from page 165)

first prints out the title and asks you if it is correct. If it is not it will then input the correct version. The computer then displays each entry and asks you if they are correct. You can then press Return if you wish it to remain as it is or you can press the space bar to delete it. If you want to change it you just type the correct version. The cursor and copy keys can be used for this. If you wish to return to the menu before the end just press Escape.

The set up printer option will configure the system for the printer you are using. The computer asks first whether you are using a serial or parallel printer. If you are using a serial printer you are shown the different baud rates that the micro uses. You must then input the rate you wish to use. The computer then performs an Osbyte call to set the speed up. This is because you cannot use variables in a *FX command.

The next option will sort the file that is currently in memory. It uses a bubble sort. This becomes quite slow if you have many items in the file, but the speed is acceptable for home use. You have the option of sorting only a part of the file or all of it.

The Print the file option prints out the file in order. It asks you if you want to use a printer and if you want to use paging. If you opt to use paging the computer reminds you that you need to press Shift key after each page. The computer will then print out the title, number of items and each entry. If you use the printer the instructions and questions will not be printed.

The sixth option will load a data file from tape, or give you a catalogue of the tape. If you just want to get a catalogue of the tape you press the Return key when asked for the name of the file. If you wish to load a file type its name when asked. The computer will then ask you to position the tape and press Return. When the computer finds the file it tells you how many items there are in the file and asks you how much extra space you want. This is to enable you to save a half-finished file and to load it later to complete it. When loading the computer prints loading so that you know all is well. When finished the computer asks you to press a key and then it returns you to the menu.

The Save-a-file option allows you to save a data file on cassette. It tells you to position the cassette at a spare section and then press Return. The computer then places the information on the tape and, when finished, asks you to press any key to return to the menu. To find out if you have a 0.1 operating system tape

*FX0

The reason you need this program is because the computer may corrupt the data as it sends it to the cassette.

The eigth option enables you to list all the entries in the file with a certain string in them. For instance you could have a file of all the articles in a magazine. For articles which have a program you could add

(Prog)

to the entry. Then, to find all the articles with a program you enter

Prog

as your search string. The routine finds substrings. There is an option to have the items that are found put on the printer, or on the screen.

The End-the-session option will end the program and return you to Basic. It would be possible to return to the program without losing the data, but you would have to use

GOTO 10

instead of Run.

(listing continued page 165)

```
  430 IF LGTH>NO THEN PRINT''"You have added the maximum amount."''"Press any key
 to continue.....": WAIT$=GET$:GOTO 30
  440 PRINT''"You can add only ";(NO-LGTH);" items."
  450 PRINT''"You will have to stop when you exceed"''"this number.To finish befo
re this type"''"$$$ as an entry."
  460 PRINT''
  470 LGTH=LGTH+1
  480 INPUTLINE"Item: "IN$
  490 IF IN$<>"$$$" THEN DT$(LGTH)=IN$ ELSE LGTH=LGTH-1
  500 IF IN$<>"$$$" AND LGTH<NO THEN 470
  510 IF IN$="$$$" THEN PRINT''"O.K." ELSE PRINT"No more items may be entered."
  520 PRINT"Press any key to continue....": WAIT$=GET$
  530 GOTO 30
  540 REM ****** CHECK FILE IN MEMORY ******
  550 CLS:PRINT TAB(7,2)"CHECK FILE ROUTINE"TAB(7,3)STRING$(18,"-")
  560 PRINT''"This will check each record.You can      start and finish at any pa
rt of the file"'' The name of the file is  ";NM$
  570 PRINT"Is this correct?";:IN$=GET$
  580 IF IN$="N" THEN INPUT''"Correct name "NM$ ELSE IF IN$<>"Y" THEN PRINT''"INP
UT ERROR!!"''"Press any key to continue...": WAIT$=GET$:GOTO 550
  590 IF LEN(NM$)<1 OR LEN(NM$)>10 THEN PRINT''"ILLEGAL NAME!!"''"Press any key to
 continue....": WAIT$=GET$:GOTO 550
  600 PRINT''" Each item will be Printed.If you wish  to change it type the cor
rect version.Ifyou wish to delete it Press the 'SPACE  BAR'.If you want it to re
main as it is  Press 'RETURN'."
  610 X=0
  620 FOR A=1 TO LGTH
  630 PRINT TAB(10,22)SPC(X)
  640 PRINT TAB(10,22)DT$(A)
  650 X=LEN(DT$(A))
  660 IN=GET:IF IN=13 THEN 710
  670 IF IN=32 THEN DT$(A)=CHR$(255):GOTO 710
  680 PRINT CHR$(IN);:INPUTLINE""DT$(A)
  690 DT$(A)=CHR$(IN)+DT$(A)
  700 PRINT TAB(0,23)SPC(LEN(DT$(A)))
  710 NEXT
  720 RETURN
  730 REM ****** SET UP PRINTER *******
  740 CLS:PRINT TAB(7,2)"PRINTER SET-UP"TAB(7,3)STRING$(14,"-")
  750 INPUT"Printer line length (0=infinite "WDH%:WIDTH WDH%
  760 INPUT"Serial or Parallel",IN$:IN$=LEFT$(IN$,1)
  770 IF IN$="P" THEN RETURN ELSE IF IN$<>"S" THEN PRINT''"INPUT ERROR!"''"Hit an
y key to continue..": WAIT$=GET$:GOTO 730
  780 PRINT''"Which baud rate?(rates available are "
  790 RESTORE 860:FOR A=1 TO 8:READ BD%,TEMP%:PRINTBD%:NEXT
  800 RESTORE 860
  810 INPUT"Rate",IBD%
  820 READ BD%,FX%
  830 IF BD%=IBD% THEN A%=8:X%=FX%:CALL &FFF4:RETURN
  840 IF BD%<9999 THEN 820
  850 PRINT"ERROR-NO SUCH RATE!"''"Hit any key to continue......": IN$=GET$:GOTO
740 REM RE-SET ALL PARIMETERS
  860 DATA 75,1,150,2,300,3,1200,4,2400,5,4800,6,9600,7,19200,8,9999,9999
  870 REM ****** SORT FILE IN MEMORY *****
  880 CLS:PRINT TAB(5,2)"SORT DATA ROUTINE":TAB(5,3)STRING$(17,"-")
  890 PRINT''"Do you wish to sort all of the file?"'TAB(5)"(Answer 'Y' or 'N')";
:IN$=GET$
  900 IF IN$="Y" THEN GOTO 1050 ELSE IF IN$<>"N" THEN PRINT"INPUT ERROR!":GOTO 8
90
  910 INPUT''"Which item to start sort from",ST%
  920 INPUT ''"Which item to end sort at",EN%
  930 REM BUBBLE SORT
  940 REPEAT
  950 FL=0
  960 FOR A%=ST% TO EN%-1
  970 IF DT$(A%)<=DT$(A%+1) THEN 990
  980 X$=DT$(A%):DT$(A%)=DT$(A%+1):DT$(A%+1)=X$:FL=1
  990 NEXT
 1000 UNTIL FL=0
 1010 FOR A=1 TO LGTH
 1020 IF DT$(A)=CHR$(255) THEN DT$(A)=""
 1030 NEXT A
 1040 RETURN
 1050 REM SORT ALL NUMBERS
 1060 ST%=0
 1070 EN%=LGTH
 1080 GOTO 930
 1090 REM ****** PRINT FILE *******
 1100 CLS:PRINT TAB(7,2)"PRINT FILE ROUTINE"TAB(7,3)STRING$(18,"-")
 1110 PRINT''"Do you wish to use the Printer (Y/N)?";:PR$=GET$
 1120 IF PR$<>"Y" AND PR$<>"N" THEN PRINT''"INPUT ERROR!!"''"Hit any key to conti
nue.....": WAIT$=GET$:GOTO 1090
 1130 PRINT''"Do you wish to use Paging (Y/N)?":PG$=GET$
 1140 IF PG$="Y" PRINT''"You will have to Press 'SHIFT' when the end of a Page i
s reached."'':VDU 14 ELSE IF PG$<>"N" THEN PRINT''"INPUT ERROR!!"''"Hit any key t
o continue..": WAIT$=GET$
 1150IF PR$="Y" THEN VDU 2
 1160 PRINT''TAB(5)"Title ";SPC(3);NM$'TAB(5)STRING$(9+LEN(NM$),"-")
 1170 PRINT''"Number of items ";LGTH
 1180 PRINT''"Items "'"------"''
 1190 FOR A=1 TO LGTH
 1200 PRINTSPC2;DT$(A)
 1210 NEXT A
 1220 IF PR$="Y" THEN VDU3
 1230 IF PG$="Y" THEN VDU15
 1240 PRINT''"Press any key to return to menu....": WAIT$=GET$
 1250 RETURN
 1260 REM ****** LOAD FILE FROM TAPE *****
 1270 CLS:PRINT TAB(7,2)"LOAD FILE ROUTINE"TAB(7,3)STRING$(17,"-")
 1280 CLEAR
 1290 PRINT''"To obtain a catalog of the tape type      'RETURN'.When finished hit
'ESCAPE' to   return to the menu."
 1300 INPUT''"File name "NM$
 1310 IF NM$<>"" THEN 1330
 1320 *CAT
 1330 IF LEN(NM$)>10 THEN PRINT''"ILLEGAL NAME!!"''"Press any key to continue...."
:WAIT$=GET$:GOTO 1300
 1340 PRINT''"Insert tape.Position before the file andPress 'RETURN'."
 1350 *M.1
 1360 REPEAT UNTIL GET=13
 1370 *M.
 1380 CHNO=OPENIN(NM$)
 1390 INPUT#CHNO,LGTH
 1400 PRINT''"Number of items ";LGTH:INPUT"Extra space "EX:IF EX<0 PRINT"Input e
rror!!":GOTO 1400 ELSE NO=LGTH+EX
 1410 DIMDT$(NO)
 1420 PRINT"Loading"
 1430 FOR A=1 TO LGTH
 1440 INPUT#CHNO,DT$(A)
 1450 NEXT
 1460 CLOSE#CHNO
 1470 VDU7:PRINT''"Finished-hit any key to return to menu..": WAIT$=GET$
 1480 GOTO 100
 1490 REM ****** SAVE FILE TO TAPE ******
 1500 CLS
 1510 PRINT TAB(7,2)"SAVE FILE ROUTINE"TAB(7,3)STRING$(17,"-")
 1520 PRINT''"Insert tape and Position at start of     spare section.Press 'RETUR
N' when ready."
 1530 *M.1
 1540 REPEAT UNTIL GET=13
 1550 *M.
 1560 CHNO=OPENOUT(NM$)
 1570 PRINT#CHNO,LGTH
 1580 FOR A=1 TO LGTH
 1590 PRINT#CHNO,DT$(A)
 1600 NEXT
 1610 CLOSE#CHNO
 1620 PRINT''"Finished-hit any key to return to the   menu....": WAIT$=GET$
 1630 RETURN
 1640 REM ***** FIND AN ITEM *****
 1650 CLS:PRINTTAB(9,2)"FIND ROUTINE"TAB(9,3)STRING$(12,"-")
 1660 PRINT''"The Program will find every occurance of the item even in the middl
e of an entry."''"e.g. it would find 'BBC' in'The BBC Cu'"
 1670 INPUT''"Item "SR$
 1680 PRINT''"Printout required?";:PR$=GET$
 1690 IF PR$="Y" THEN VDU 2 ELSE IF PR$<>"N" THEN PRINT''"INPUT ERROR!!"''"Hit any
key to continue....": WAIT$=GET$:GOTO 1680
 1700 PRINT''"Search item  ";SR$'
 1710 FF=FALSE
 1720 FOR A=1 TO LGTH
 1730 T$=DT$(A)
 1740 IF LEN(T$)<LEN(SR$) THEN 1790
 1750 FOR L=1 TO (LEN(T$)-LEN(SR$))
 1760 X$=MID$(T$,L,LEN(SR$))
 1770 IF SR$=X$ PRINT DT$(A):A FF=TRUE
 1780 NEXT L
 1790 NEXT A
 1800 IF FF=FALSE PRINT"No items under that name found"
 1810 IF PR$="Y" THEN VDU3
 1820 PRINT''"Hit any key to return to menu...": WAIT$=GET$
 1830 RETURN
 1840 REM ****** END PROGRAM *******
 1850 MODE7:PRINT TAB(10,10)"BASIC ready."
 1860 END
```

Astrogladiator

P Edmond,
Driffield,
East Yorkshire.

VIC-20

YOU HAVE two minutes in which to destroy as many alien gladiators as possible in the cosmic arena. The game is intended for use with an unexpanded Vic-20. Do not insert unnecessary spaces into the program lines when entering the game since virtually all the memory of an unexpanded Vic is consumed.

Use the full stop and comma keys to rotate your ship clockwise and anti-clockwise, use the question mark key to fire and the Shift and Commodore keys to move your ship at various speeds. This game is probably the first to use an enlarged screen window on an unexpanded Vic. The stellar background covers your entire television screen due to a memory map of 1,008 bytes — 28 by 36.

(continued on next page)

(continued from previous page)

You may have tried enlarging the screen size by Poking locations 36866 and 36867 but without extra memory added to your Vic the memory map of the screen runs past 8192 and there is no information as to what to put on the screen, resulting in jumbled characters.

In this program, though, before increasing the screen size, 128 is subtracted from location 36866 so that the screen map starts at 7168 instead of 78680, leaving 1K for screen memory.

Juggling 36866 and 36867 again gives a screen size of 28 across by 36 down which is centred on the television screen by Poking locations 36864 and 36865.

A user-defined graphics/character set is fitted between 6144 and 7168, explaining why the program is so short — there is only 2K of memory left. If you are wondering what

PEEK (633)

is in line 36, it simply determines what combination of Shift, Commodore or Ctrl keys are being pressed.

```
1 POKE56,24:POKE52,24:CLR:GOSUB9000:POKE36879,8:PRINTCHR$(8):A=30720:D(6)=29
2 VS=36877:VI=36878:POKEVI,15:L=0:D(1)=-1:D(2)=-29:D(3)=-28:D(4)=-27:D(5)=1
3 D(7)=28:D(8)=27:W(1)=64:W(2)=77:W(3)=93:W(4)=78:W(5)=64:W(6)=77:W(7)=93
4 POKE36866,28:POKE36867,72:POKE36864,7:POKE36865,19:POKE648,28:PRINT"J"
5 POKE648,30:PRINT"J":FORI=0TO5:POKE7674+I,32:POKE7674+A+I,1:NEXT:W(8)=78
6 P=7680:R=1:U1=32:U=7800:R1=1:FORI=1TO99:POKE7168+RND(1)*1008,74+RND(1)*2
7 NEXT:P1=32:FORI=1TO15:POKE7168+RND(1)*1008,76:NEXT:TI$="000000"
30 T=PEEK(197):Q=0:IFT=29THENQ=-1:POKEVS-1,225
32 IFT=37THENQ=1:POKEVS-1,227
33 IFT=30THEN100
34 R=R+Q:IFR<1THENR=8
35 POKEVS-1,0:IFR>8THENR=1
36 POKEP,P1:P=P+PEEK(653)*D(R):IFP>8176THENP=P-1008
37 IFP<7168THENP=P+1008
38 P1=PEEK(P):POKEP,65+R:POKEP+A,7:IFP1=65+R1THEN200
40 IFRND(1)>.6THENR1=R1+INT(RND(1)*3)-1:POKEVS,235+RND(1)*18
42 IFR1<1THENR1=8
43 IFR1>8THENR1=1
44 POKEVS,0:POKEU,U1:U=U+D(R1):IFU>8176THENU=U-1008
45 IFU<7168THENU=U+1008
46 U1=PEEK(U):POKEU,65+R1:POKEU+A,5:IFU1=65+RTHEN200
49 IFTI$<"000200"THEN30
50 PRINT"TIME'S UP ! ";
51 PRINT"                    YOU SCORED"SC:SC=0:FORI=1TO3000:NEXT:WAIT197,63:GOTO2
100 IFF<>0THEN110
102 Y=D(R):F1=R+65:F=P:L=0:K=R:G=PEEK(36868)OR128
110 POKEVS-1,G::F=F+Y:F1=PEEK(F):POKEF,W(K)
111 IFF<7168ORF>8176THENPOKEF,F1:F=0:POKEVS-1,0:GOTO34
120 POKEVS-1,0:IFF1=R1+65THEN132
121 L=L+1:IFL=12THENPOKEF,F1:F=0:GOTO34
122 POKEF,F1:GOTO110
129 POKEU,42:FORI=1TO4:FORJ=1TO8:POKEU+D(J)*I,RND(1)*2+74:POKEVS,220+J*3:NEXTJ,I
130 FORI=1TO4:FORJ=1TO8:POKEU+D(J)*I,32:POKEVI,15-I*3:NEXTJ,I
131 POKEVS,0:POKEVI,15:POKEU,32:U=7168+INT(RND(1)*28):U1=32:F=0:R1=INT(RND(1)*8
+1):RETURN
132 GOSUB129:SC=SC+1:FORI=1TO10:POKE7168+RND(1)*1008,RND(1)*2+74:NEXT:GOTO34
200 GOSUB129:PRINT" YOU COLLIDED";:GOTO51
9000 FORI=0TO1023:POKE6144+I,PEEK(32768+I):NEXT:POKE36869,254:FORI=0TO87:READA
9010 POKE6672+I,A:NEXT:RETURN
9020 DATA0,7,30,254,30,7,0,0,0,64,48,60,31,30,12,4,16,16,16,56,56,124,124,68
9030 DATA0,2,12,60,248,120,48,16,0,224,120,127,120,224,0,0,16,48,120,248,60,12
9040 DATA2,0,68,124,124,56,56,16,16,16,8,12,30,31,60,48,64,0,0,0,8,0,0,0,0,0,0
9050 DATA0,0,0,64,0,0,0,0,0,0,6,6,0,0,0
```

Astrogladiator listing

Island of zombies

Alan Fyfe,
Edinburgh.

DRAGON

THIS PROGRAM is a Dragon version of the popular game where a target is followed by blind zombies. In this version, the target — a black diamond — moves on directional orders from the keyboard. On each move the zombies, represented by yellow squares, converge on the target. The aim is to lure them all into the pits — black squares — dotted all over the island. The game is one of strategy rather than speed.

Lines 60 to 130 set up the island with a random number — 21 to 30 — of black pits. The RND function does not generate true random numbers and a useful dodge to prevent the same pattern occurring on each "first" game is found in line 2150. The computer generates needless random numbers while waiting for a response to line 2130. Lines 2120 and 2140 mean that this routine is missed on all but the first game.

Lines 200 to 370 set up a random number — 12 to 16 — of zombies and a random position for the target. Lines 280 to 290 check that there are no zombies immediately adjacent to the target at the start of the game.

Lines 500 to 680 read the direction and, using the Instr function, move the target. If a string other than a direction is input then the program passes to line 2500. If the target moves into the sea, a pit or a zombie, the game ends.

Lines 700 to 990 move the zombies. The X and Y co-ordinates of the target are compared with the position of each zombie in turn. If both differ, the zombie moves diagonally towards the target. If one set of co-ordinates is the same, the zombie position merely increments along that co-ordinate. This is taken care of in line 770 to 780 and associated subroutines. Lines 800 to 820 check to see whether the zombie is walking into a pit, another zombie or the target. If so then appropriate action is taken in lines 910 and after.

Line 70 accelerates the action of the program by engaging the dual-rate of the microprocessor. If the game is finished through program control, line 1510 switches off the dual rate. If the game is finished by the Break key, the reset button will have to be pressed before saving or loading another program.

```
10 'ISLAND OF ZOMBIES'
20 'BY ALAN FYFE - MARCH 1983'
30 DIM N(384),XZ(16),YZ(16)
58 '
59 'SETTING UP ISLAND'
60 CLS4:GOSUB2000
70 POKE&HFFD7,0
80 FOR I=33TO350:N(I)=143:NEXTI
90 FOR I=0TO32:N(I)=175:NEXTI
100 FOR I=63TO351STEP32:N(I)=175:N(I+1)=175:NEXTI
110 FOR I=353TO383:N(I)=175:NEXTI
120 R=RND(10)+20
130 FOR J=1TOR:P=RND(10):Q=RND(30):N(P*32+Q)=128:NE
XTJ
198 '
199 'ZOMBIES AND TARGET'
200 S=RND(5)+11:Z=S
210 FOR K=1TOS
220 P=RND(10):Q=RND(30)
230 IF N(P*32+Q)=128 THEN 220
240 XZ(K)=Q:YZ(K)=P
250 N(P*32+Q)=159:NEXTK
260 P=RND(8):Q=RND(28):U=(P+1)*32+Q+1
270 IF N(U)<>143 THEN 260
280 FOR I=1TO3:FOR J=0TO64STEP32
290 IF N(U-34+I+J)=159 THEN260
300 NEXT J,I
310 XT=Q+1:YT=P+1
320 N(U)=42
330 SOUND200,5:PRINT@402,"   PRESS space TO BEGIN
  ";:SOUND200,5
340 I$=INKEY$:IF I$="" THEN 340
350 CLS3
360 FOR K=0TO383:PRINT@K,CHR$(N(K));:NEXTK
370 GOSUB1500
498 '
499 'MOVING TARGET'
500 PRINT@417,"THERE ARE";Z;"ZOMBIES AFTER YOU";
510 IF Z=0 THEN1210
520 PRINT@449,"WHICH WAY";:INPUT W$
530 XS=XT:YS=YT
540 IF INSTR(1,W$,"N")>0 THEN YS=YT-1
550 IF INSTR(1,W$,"S")>0 THEN YS=YT+1
560 IF INSTR(1,W$,"W")>0 THEN XS=XT-1
570 IF INSTR(1,W$,"E")>0 THEN XS=XT+1
580 IF XS=XT AND YS=YT THEN GO TO 2500
590 V=YS*32+XS
600 PRINT@(YT*32+XT),CHR$(143);
610 N(YT*32+XT)=143
620 GOSUB1500
630 IF N(V)=175 THEN 1000
640 IF N(V)=128 THEN 1040
650 IF N(V)=159 THEN 1080
660 YT=YS:XT=XS
670 PRINT@V,CHR$(42);
680 N(V)=42
699 '
700 'MOVING ZOMBIES'
710 PRINT@417,"LOOK OUT! HERE COME THE ZOMBIES";:PR
INT@449,"THERE ARE";Z;"OF THEM";
720 FOR I=1TOS:XU=XZ(I):YU=YZ(I):U=YU*32+XU
730 IF XU=999 THEN980
740 FOR L1=1TO3
750 PRINT@U,CHR$(143);:FOR L2=1TO25:NEXTL2
760 PRINT@U,CHR$(159);:FOR L2=1TO25:NEXTL2,L1
770 ON SGN(XU-XT)+2 GOSUB850,860,870
780 ON SGN(YU-YT)+2 GOSUB880,890,900
790 PRINT@U,CHR$(143);:N(U)=143:V=YU*32+XU
800 IF N(V)=128 THEN 910
810 IF N(V)=159 THEN 940
820 IF N(V)=42 THEN 1240
830 XZ(I)=XU:YZ(I)=YU:PRINT@V,CHR$(159);:N(V)=159
840 PLAY"T201C":GOTO 980
850 XU=XU+1:RETURN
860 RETURN
870 XU=XU-1:RETURN
880 YU=YU+1:RETURN
890 RETURN
900 YU=YU-1:RETURN
910 PRINT@416,STRING$(64,191);:PRINT@417,"THERE GOE
S A ZOMBIE DOWN A HOLE";
920 PLAY"T15O05GCO4GCO3GCO2GCO1GT50ECECECECECECECEC
ECECECETSC"
930 Z=Z-1:XZ(I)=999:GOTO 970
940 PRINT@416,STRING$(64,191);:PRINT@417,"ONE ZOMBI
E SQUASHED ANOTHER";
950 PLAY"O1T2CP50CP50C"
960 Z=Z-1:XZ(I)=999:IF Z=0 THEN 1210
970 PRINT@449,"THERE ARE";Z;"ZOMBIES LEFT";
980 NEXT I
990 GOTO 370
998 '
999 'MISHAPS TO TARGET'
1000 PRINT@417,"YOU FELL IN THE SEA AND DROWNED";
1010 PLAY"T4005"
1020 FOR D=1TO4:PLAY"BAGFEDCO-":NEXT D:PLAY"BAGFEDC
"
1030 GOTO1200
1040 PRINT@417,"YOU STEPPED IN A BOTTOMLESS PIT";
1050 PLAY"T405FEO4FEO3FEO2FEO1FT50"
1060 FOR D=1TO25:PLAY"EC":NEXT D
1070 GOTO 1200
1080 PRINT@417,"YOU WALKED INTO A ZOMBIE.IDIOT";
1090 FOR D=1TO8:PLAY"T16O1GFEFE":NEXT D
1198 '
1199 'END OF GAME'
1200 PRINT@449,"ANOTHER GO";:INPUT A$:IF LEFT$(A$,1
```

(continued on page 170)

wildings

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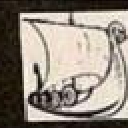
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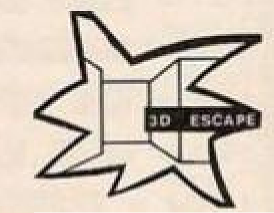
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(continued from page 168)

```
)="Y" THEN60 ELSE 1510
1210 GOSUB1500
1220 PRINT@417,"CONGRATULATIONS- YOU SURVIVED!";
1230 GOTO1200
1240 GOSUB1500
1250 PRINT@V,CHR$(191);
1260 PRINT@417,"YOU WERE CAUGHT BY A ZOMBIE";
1270 GOTO 1090
1498 '
1499 'DELETE PREVIOUS TEXT'
1500 PRINT@416,STRING$(64,191);:RETURN
1510 POKE&HFFD6,0:END
1998 '
1999 'INTRODUCTION'
2000 PRINT@34,"YOU ARE MAROONED ON A DESERT";
2010 PRINT@66,"ISLAND WHICH IS COVERED WITH";
2020 PRINT@98,"BOTTOMLESS PITS AND INFESTED";
2030 PRINT@130,"WITH ZOMBIES. THESE HORRIBLE";
2040 PRINT@162,"CREATURES CANNOT SEE BUT CAN";
2050 PRINT@194,"HEAR VERY WELL WHEN YOU MOVE";
2060 PRINT@226,"AROUND. THE TRICK IS TO LURE";
2070 PRINT@258,"THEM INTO THE PITS.         ";
2080 PRINT@322,"ENTER EACH MOVE AS A COMPASS";
2090 PRINT@354,"DIRECTION (N,SW,ETC).       ";
2100 PRINT@418," =YOU    =ZOMBIE    =PIT ";
2110 PRINT@419,CHR$(42);:PRINT@428,CHR$(159);:PRINT
@440,CHR$(128);
2120 IF KEY=1 THEN 2170
2130 SOUND100,5:PRINT@482,"PRESS space TO SET UP IS
LAND";:SOUND100,5
2140 KEY=1
2150 I$=INKEY$:I=RND(10):IF I$=""THEN 2150
2160 PRINT@482,STRING$(28,191);
2170 RETURN
2498 '
2499 'NON-DIRECTION KEY PRESSED'
2500 GOSUB1500
2510 PRINT@417,"SORRY- YOU MAY NOT JUST JUMP UP";
2520 PRINT@449,"AND DOWN ON THE SPOT!";
2530 FOR F4=1TO2000:NEXT F4
2540 GOTO 370
```

Kong jump

Graham Fitter,
Hassocks,
West Sussex.

ZX-81

IN THIS GAME, for the 16K ZX-81 the player has to move his man along a black wall, jumping over the holes, and jumping over the barrels that Kong is throwing at you. A point is given for jumping a set of barrels, and 25 points are given for jumping on the home at the end of the course, which changes when you jump on to the home.

Use keys 5 and 8 to move the man left and right. These keys shifted will jump the man in those directions, and Shifted 7 will push the man upwards.

```
  70 CLS
  80 GOSUB 430
  90 LET O=1
 100 LET A=1
 110 LET B=A
 120 LET C=26
 130 LET S=0
 140 LET K=C
 150 LET L=A
 160 LET N=L+L
 170 LET P=C
 180 LET T=L-L
 190 PRINT AT PI,T;A$(O);TAB 27;
" ██ ";TAB T;"████████████████████
████████████████";TAB T;"██████████
██████████████████";TAB T;"█
███████████████████████ █ █";
TAB 27;" █  █ "
 200 PRINT AT N,K;"H";AT N,C;"OO
O ";AT A,B;"O";TAB B;"L" AND INK
EY$="8";TAB B;"L" AND INKEY$=CHR
$ 115;TAB B;"L" AND INKEY$="";TA
B B;"J" AND INKEY$="5";TAB B;"J"
 AND INKEY$=CHR$ 114;TAB B;"X" A
ND INKEY$=CHR$ 112;AT A+N,B;
 210 LET E=PEEK (PEEK 16398+256*
PEEK 16399)
 220 IF A=L AND B=C OR A=L AND B
=C+N OR A=L AND B=C+N+N OR A>=N
THEN GOTO 360
 230 IF E<>128 THEN LET A=A+L
 240 LET S=S+(E=P+P)+P*(E=45)
 250 IF E=45 THEN GOTO 320
 260 LET C=C-1
 270 IF C=T THEN LET C=P
 280 LET B=B+(INKEY$="8" OR INKE
Y$=CHR$ 115)-(INKEY$="5" OR INKE
Y$=CHR$ 114)
 290 IF E=128 AND INKEY$>=CHR$ 1
12 THEN LET A=A-L
 300 PRINT AT N,T;"      ";AT T,B
-L;"   ";TAB B-L;"   ";TAB B-L;"
 "
 310 GOTO 200
 320 LET K=K+((P-L)*(K=L))-((P-L
)*(K=P))
 330 LET O=O+1
 340 IF O>10 THEN LET O=1
 350 GOTO 190
 360 PRINT AT 5,0;"SCORE ";S
 370 PRINT AT 7,4;"GAME OVER"
 380 PRINT AT 8,2;"PRESS ANY KEY
TO START"
 390 IF INKEY$<>"" THEN GOTO 395
 391 PRINT AT 2,27;"    ";TAB 27
;" █  ";TAB 27;"████";TAB 27;"█
██";TAB 27;" █ █ ";TAB 27;"█
█";TAB 27;" █O "
 392 IF INKEY$<>"" THEN GOTO 395
 393 PRINT AT 2,27;"█ █";TAB 27
;"████";TAB 27;" █  ";TAB 27;"
█ █ ";TAB 27;"█  █";TAB 27;"
 "
 394 GOTO 390
 395 FOR A=8 TO 20
 396 PRINT AT A,27;" █O ";AT A-
1,27;"    "
 397 NEXT A
 398 PRINT AT 18,28;"█";AT 19,2
9;"█"
 399 FOR A=0 TO 50
 400 NEXT A
 410 CLS
 420 RUN
 430 DIM A$(10,27)
 440 LET A$(1)="████ ████ ███
██ ███ ████"
 450 LET A$(2)="██ █ █ █ █ █ █ █
█ █ █ █ ██"
 460 LET A$(3)="██ ███ █ ██ █ ██
█ █ █ ██ ██"
 470 LET A$(4)="█████████████████
██████████"
 480 LET A$(5)="██ █ ██ ███ ████
█ ██ ███ █"
 490 LET A$(6)="███ ███ █ ██ ███
█ █████ █ █"
 500 LET A$(7)="█████ ██ ██ █ ███
█ ██ ███ ██"
 510 LET A$(8)="██ ██ ██ ████ █
███ ██ █ ████"
 520 LET A$(9)="███ █ ██ ███ █ █
██ ████ ██"
 530 LET A$(10)="████ ████ ████
████ ███ ██"
 540 RETURN
 550 SAVE "KONG"
 560 RUN
```

Time clock

A S P Heald,
Leeds.

DRAGON

I FOUND a decent clock program for the Dragon 32 computer was necessary due to the inadequacy of the Dragon's timer function. This function is reset to zero every 21.8 minutes, making it impractical for use as an ordinary clock. It is only really useful as a simple timer: as its name suggests.

The actual clock program is written in machine code. It is driven by the Dragon's analogue timer, which is linked directly to the 6809's IRQ interrupt pin. This timer causes an interrupt every 0.02 seconds.

The clock routine is entered when the IRQ is triggered. Then it increments the time by a 0.02 seconds. The time is stored in a four-byte table. Each byte contains hours, minutes, seconds, 0.02 seconds, respectively.

The clock program consists of the interrupt-handling routine, a routine to start the clock and one to stop it. In order to set the time the stop routine should be called, then the required time Poked into the time-table, then the Start routine should be called. To read the clock the time-table should be Peeked.

The Basic program entitled Clock Loader will put the machine code into memory ready for use. The routine can be located anywhere in memory, being written in entirely relocatable code, and so the loader first asks where the user wishes it to be positioned.

A good place to put the code is in the first graphics page, so long as it is not used for graphics, of course, in which case the user should enter 1536 as the start address. The machine code will then be put into memory at the specified point. Following this the loader displays the entry points for the start and stop routines, and the locations of the time table bytes. These should be noted for future use. After this the Basic program can be deleted from memory.

(continued on page 179)

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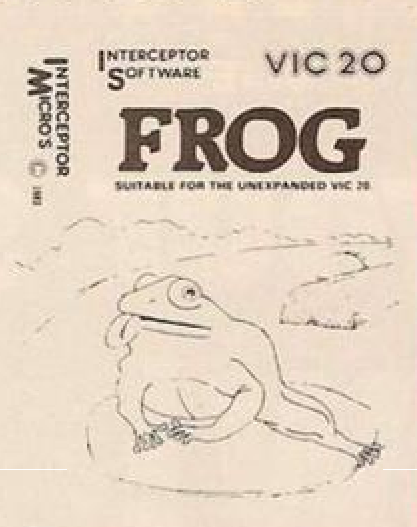
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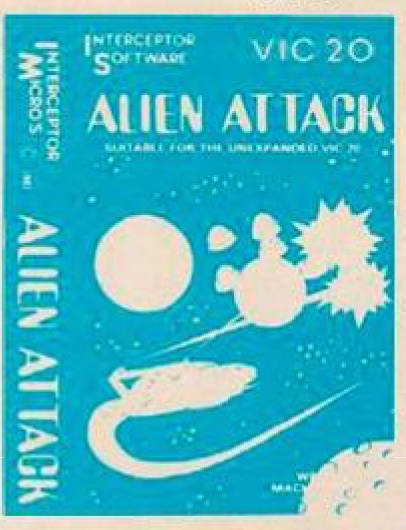
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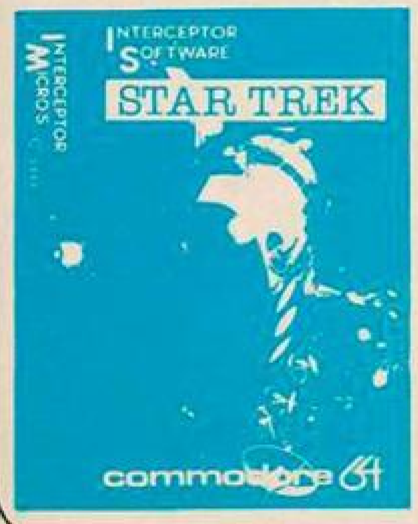


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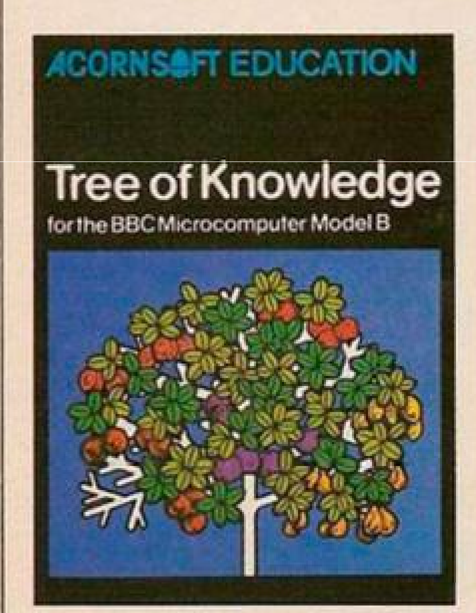
The BBC Microcomputer system is generally regarded to be the best micro in its price range you can lay your hands on. So, if you're thinking of buying one or already own one, you'll want to know about the software that's been specially designed for it.

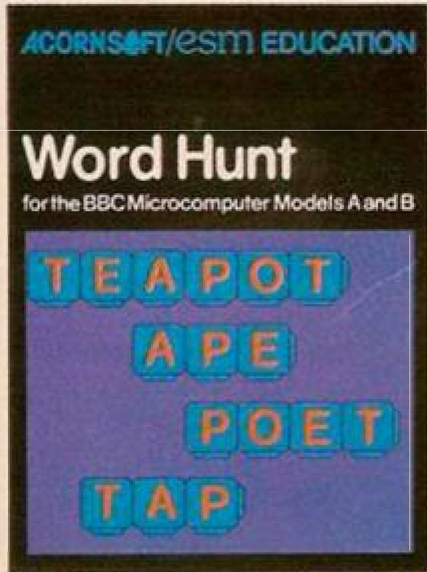
Not surprisingly, it's made by Acornsoft, the software division of Acorn Computers Ltd., who designed and built the BBC Microcomputer. So naturally you can expect the highest quality software with the built-in ingenuity to fully exploit the BBC Micro's potential.

Further education for everyone.

Tree of Knowledge (£9.95) is an interactive program for children of all ages teaching categorisation. It illustrates some of the more practical aspects of computing in that the pupil first educates the computer, building up a database by answering the computer's questions, and the database is then used to play games of deduction and logic.

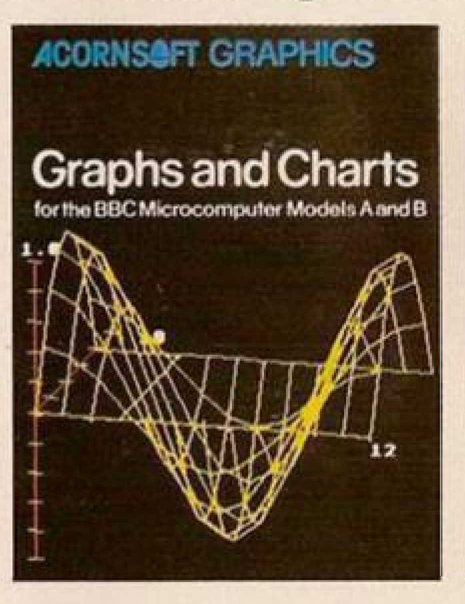
Word Hunt (£11.90) is a set of four programs, each containing a list of nine words. The object of the exercise is to select one word and then try to create as many smaller words as possible from the selected word.

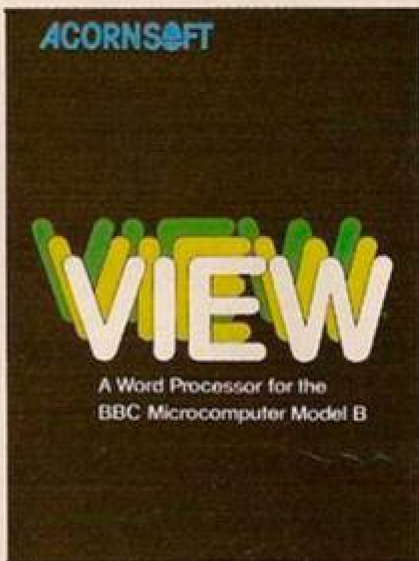




Increase your business acumen.

Graphs and Charts (price £17.45) which includes the book 'Graphs and Charts on the BBC Microcomputer' contains a set of programs to present data graphically in a wide range of applications. The graphs include automatic scaling, labelling of axes and use of colours.

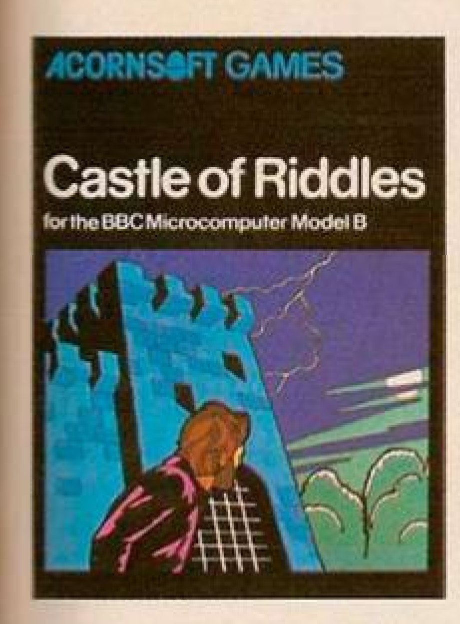


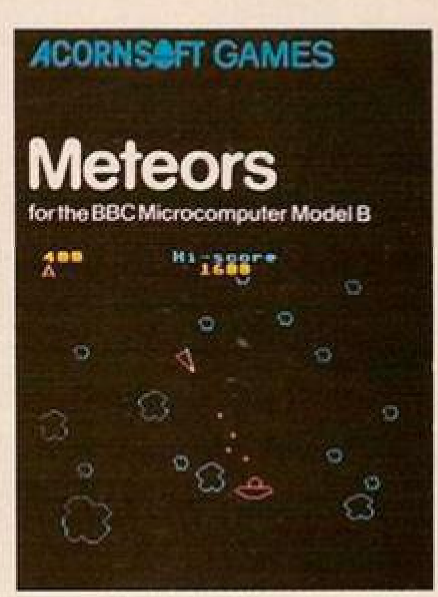


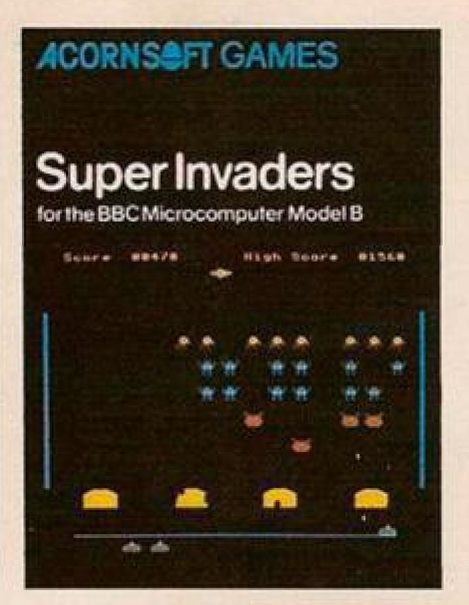
And VIEW (price £59.80) a program that enables your machine, together with a printer, to operate as a fully operational word processor. For convenience the program is in ROM so that it can become a permanent feature of your machine. (It can easily be fitted by your local dealer). You'll find out more by going to your dealer or by sending for the free catalogue.

Mind-boggling games.

Castle of Riddles (price £9.95) is a magical adventure, with wizardry and hocus pocus of all kinds; booby traps and fiendish riddles to be unravelled along the tortuous route to the Magic Ring of Power. Your reward is to keep the







treasure you find along the way.

Meteors (price £9.95) is a game where you have to manoeuvre your laser-ship through a hail of meteors, smashing them with your laser bolts as they hurtle towards you on all sides. Complete with sound effects and table of Hi-Scores.

Super Invaders (price £9.95) is a fight against invading aliens. The only way to resist and avoid subsequent annihilation is to destroy the aliens before they land. You have three mobile launchers whose hyper-velocity missiles will instantly vaporise their target on impact. This game includes high-score, and is fully compatible with either keyboard or joysticks.

Understanding computers.

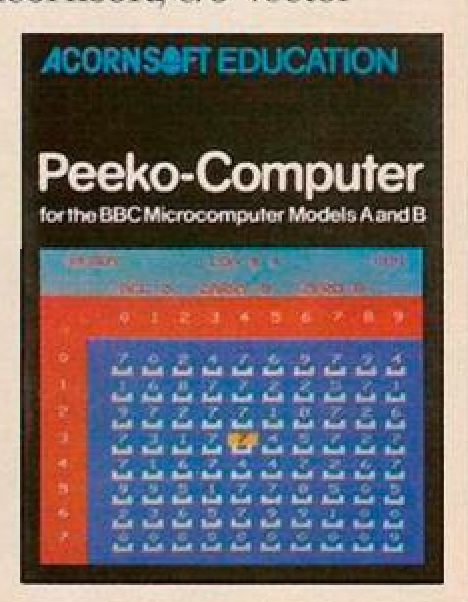
Peeko-Computer (price £9.95) simulates the operation of a simplified microcomputer in order to teach the fundamentals of machine-code programming. It comes complete with a 16 page instruction manual including exercises and examples, and the cassette features five demonstration Peeko-Computer programs.



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If you're a credit card holder and would like to buy cassettes of the programs shown in this advertisement, or if you would like to know the address of your nearest stockist, just phone 01-200 0200.

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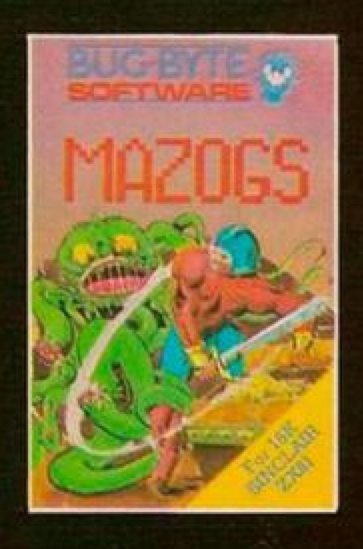
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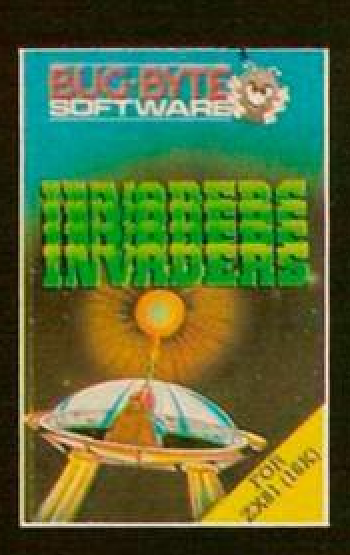
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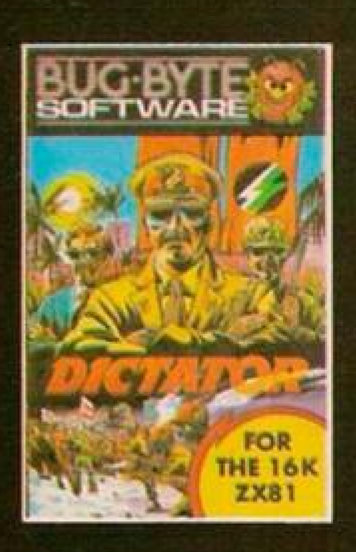
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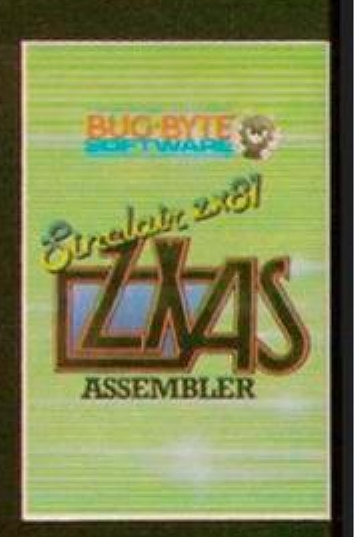


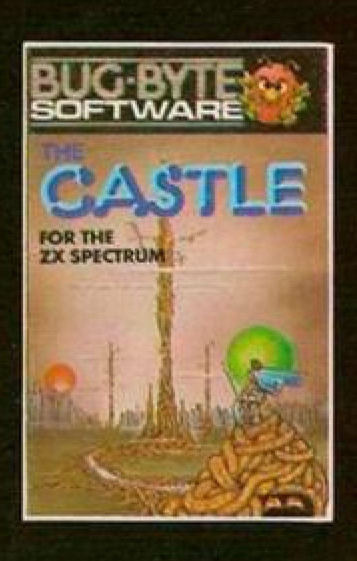


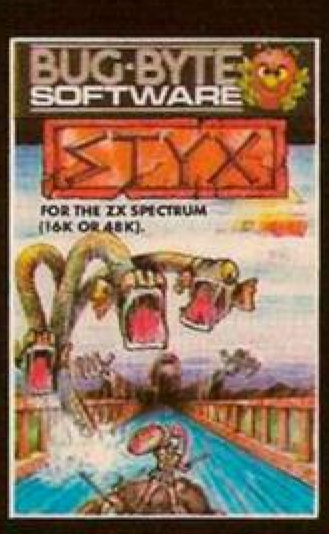


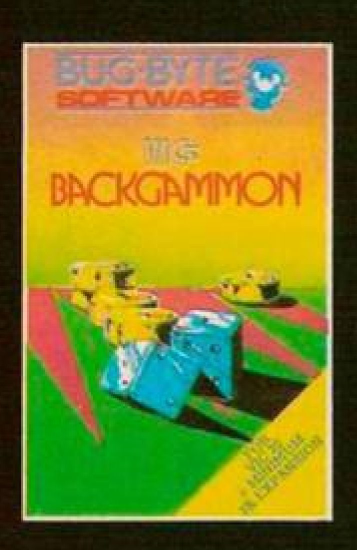




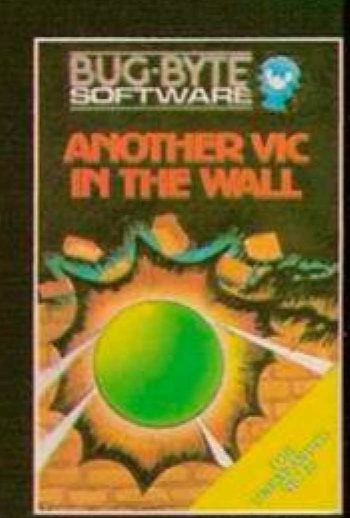






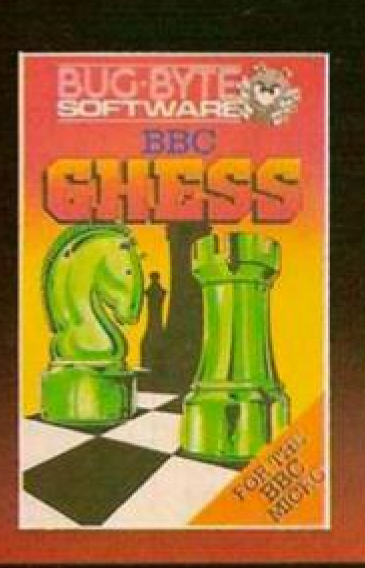












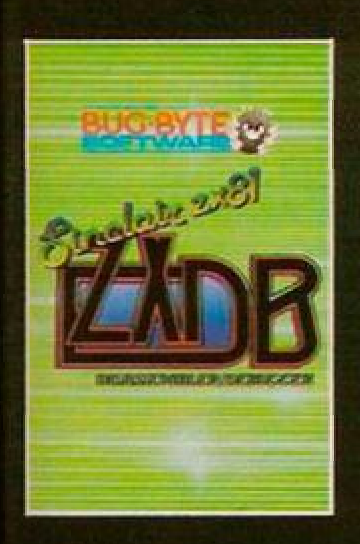




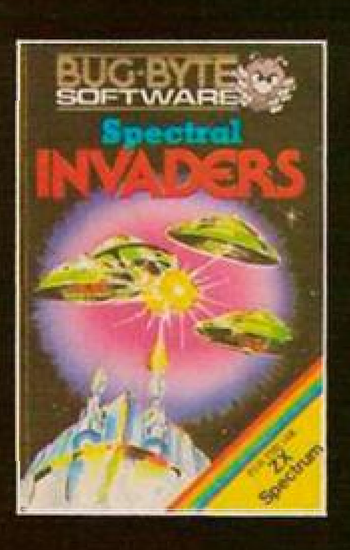


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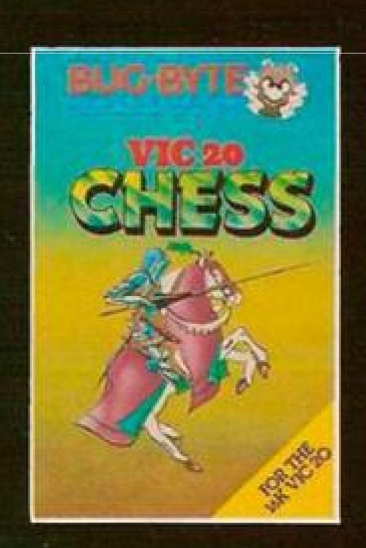


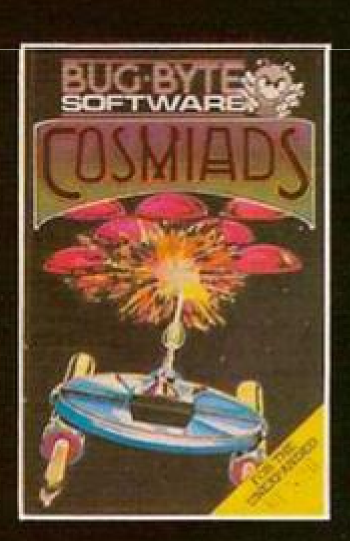




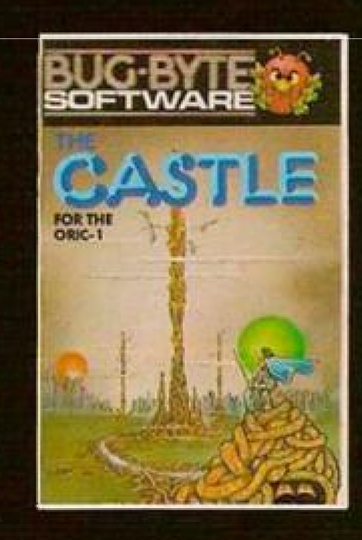


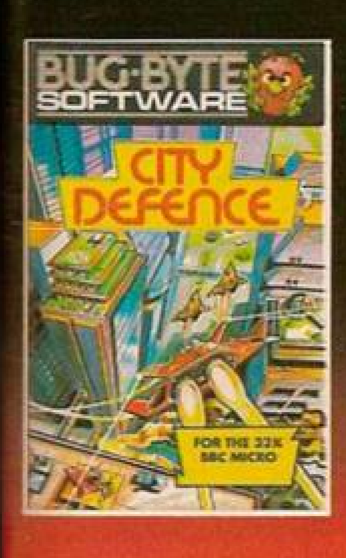
















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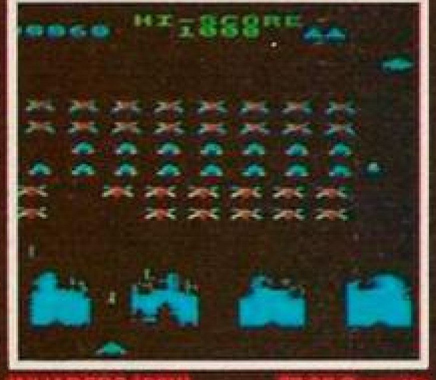


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(continued from page 170)

Once the machine code has been put into memory it can be saved using

CSAVEM "CLOCK", S, S+84,S

where S is the start address of the routine. The second Basic program, entitled Clock Demonstration, is a short demonstration of the use of the clock. This program also requires the user to enter the start address of the machine code. The user must then enter the time in hours and minutes as on the 24-hour clock.

Line 170 sets up pointers to the hours, minutes, and seconds registers in the time table.

Line 180 sets the time: here the clock-start routine automatically sets the seconds and 0.02 seconds registers to zero, and does the same with hours and minutes if they are not in the range 0 to 23, or 0 to 59, respectively. Line 200 displays the time on the screen, which is continually updated.

```
100 CLS:PRINT "CLOCK LOADER"
110 PRINT "(C) 1983 BY A.S.P.HEALD":PRINT
120 INPUT "START ADDRESS";S
130 FOR A=S TO S+84
140 READ H$:POKE A,VAL("&H"+H$)
150 NEXT A
160 PRINT:PRINT "USE EXEC";S;"TO START CLOCK"
170 PRINT "USE EXEC";S+30;"TO STOP IT"
180 PRINT:PRINT "DATA LOCATIONS:"
190 PRINT "HOURS AT";S+81
200 PRINT "MINS AT";S+82
210 PRINT "SECS AT";S+83
220 PRINT "1/50 SECS AT";S+84
230 PRINT
240 DATA 30,CC,51,6F,84,6F,82,86
250 DATA 3B,A1,82,24,02,6F,84,86
260 DATA 17,A1,82,24,02,6F,84,30
270 DATA CC,0B,BF,01,0D,39,8E,9D
280 DATA 3D,BF,01,0D,39,30,CC,2C
290 DATA 6C,84,86,32,A1,84,26,1E
300 DATA 6F,84,6C,82,86,3C,A1,84
310 DATA 26,14,6F,84,6C,82,A1,84
320 DATA 26,0C,6F,84,6C,82,86,18
330 DATA A1,84,26,02,6F,84,7E,9D
340 DATA 3D,00,00,00,00
```

```
100 CLS:PRINT "CLOCK DEMONSTRATION"
110 PRINT "(C) 1983 BY A.S.P.HEALD"
120 PRINT
130 INPUT "START OF CLOCK ROUTINE";SR
140 PRINT
150 INPUT "TIME: HOURS";TH
160 INPUT "       MINS ";TM
170 H=SR+81:M=SR+82:S=SR+83
180 EXEC SR+30:POKE H,TH:POKE M,TM: EXEC SR
190 CLS:PRINT@195,"TIME:"
200 PRINT@200,PEEK(H);PEEK(M);PEEK(S)
210 GOTO 200
```

Snakman

R S Burdon,
Lichfield,
Staffordshire.

SPECTRUM

SNAKMAN for the 16K Spectrum involves manoeuvring a snake, using the cursor keys, around the maze. The object of the game is to consume as many eggs as you can without crashing into the sides of the maze. Your snake increases by one segment every time four eggs are eaten. Biting your tail is fatal and so is doubling back on to yourself. Bonus cherries appear in the middle of the maze and these have to be quickly consumed before they disappear.

The program includes the top three high scores and an arcade-style way of entering your name, operated by left, right and up cursor keys. Three jingles are played at different parts of the program and the score high-scorer and lives are visible at all times.

```
   1 REM SNAKMAN © MCMLXXXIII
   2 REM   By Richard Burdon
   3 GO SUB 9000: LET h$="SNAKMA
N": LET i$="SNAKMAN": LET j$="SN
AKMAN": LET hi=500: LET h2=500:
LET h3=500
   5 LET no=0: LET lives=3: LET
s=0: LET d=0
  10 BORDER 7: PAPER 7: CLS : IN
K 0: GO SUB 4000: INK 2: GO SUB
1000: INK 1
  11 PRINT AT 0,11;"SCORE"
  12 PRINT AT 0,22;"LIVES "
  15 PRINT AT 0,0;h$
  20 LET y$=CHR$ 10+CHR$ 10
  21 LET x$=CHR$ 15+CHR$ 16
  40 LET a$="●"
  45 FOR z=1 TO lives: PRINT AT
0,(27+z);"●": NEXT z
  60 LET l=2
  70 LET d=0
 200 LET x=CODE x$
 205 IF d>=376 THEN GO TO 10
 210 IF INKEY$="8" THEN LET x=x+
1: LET a$="●"
 212 IF INKEY$="5" THEN LET x=x-
1: LET a$="●"
 220 LET y=CODE y$
 230 IF INKEY$="7" THEN LET y=y-
1: LET a$="●"
 232 IF INKEY$="6" THEN LET y=y+
1: LET a$="●"
 250 IF x=CODE x$ AND y=CODE y$
THEN LET x=x+x-CODE x$(2): LET y
=y+y-CODE y$(2)
 260 IF ATTR (y,x)=58 OR ATTR (y
,x)=41 THEN GO SUB 3500
 262 IF ATTR (y,x)=34 THEN LET s
=s+1: LET d=d+1: LET l=l+.25: BE
EP .01,1
 264 IF ATTR (y,x)=57 THEN GO SU
B 3500
 270 IF ATTR (y,x)=43 THEN PRINT
 AT 0,0; FLASH 1;"BONUS 20!"; FL
ASH 0: GO SUB 6110: LET s=s+20:
LET no=150: PRINT AT 0,0;"
   ";AT 0,0;h$
 290 PRINT AT 0,17;s
 295 PRINT PAPER 5;AT CODE y$(1)
,CODE x$(1);"●"
 300 PRINT PAPER 5;AT y,x;a$
 400 PRINT PAPER 5; INK 5;AT COD
E y$(l),CODE x$(l);" "
 500 LET x$=CHR$ x+x$( TO l)
 510 LET y$=CHR$ y+y$( TO l)
 600 LET no=no+1
 610 IF no>100 THEN PRINT INK 3;
PAPER 5;AT 10,15;"●●"
 620 IF no>150 THEN PRINT INK 5;
PAPER 5;AT 10,15;"  ": LET no=0
 999 GO TO 200
1000 FOR n=0 TO 20: NEXT n
1010 FOR n=2 TO 20: PRINT PAPER
4;AT n,1;"●●●●●●●●●●●●●●●●●●●●●●
●●●●●●●●": BEEP .02,n: NEXT n
1015 FOR n=7 TO 12: PRINT PAPER
5;AT n,6;"                    ":
 BEEP .02,n: NEXT n
1020 FOR n=20 TO 1 STEP -1: PRIN
T AT n,0;"█";AT n,31;"█": BEEP .
01,n: NEXT n
1025 PRINT AT 1,0;"█████████████
███████████████████";AT 21,0;"█
███████████████████████████████"
1030 PRINT AT 4,3;"█████████";AT
 4,14;"████";AT 4,20;"█████████"
1040 PRINT AT 7,3;"█";AT 7,6;"█
████████";AT 7,17;"█████████";AT
 7,28;"█"
1050 PRINT AT 8,3;"█";AT 8,6;"█"
;AT 8,25;"█";AT 8,28;"█"
1060 PRINT AT 11,3;"█";AT 11,6;"
█";AT 11,25;"█";AT 11,28;"█"
1070 PRINT AT 12,3;"█";AT 12,6;"
█████████";AT 12,17;"█████████";
AT 12,28;"█"
1080 PRINT AT 15,3;"████████████
";AT 15,17;"████████████"
1090 PRINT AT 18,3;"██";AT 18,7;
"█████████";AT 18,17;"█████████";A
T 18,27;"██"
```

(continued on page 181)

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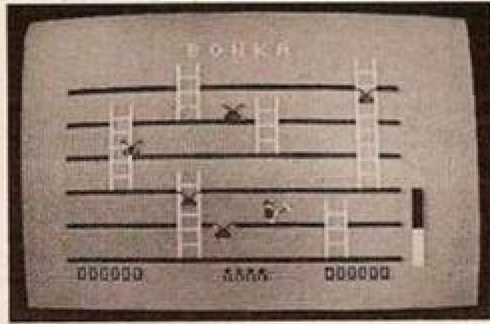
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(continued from page 179)

```
1999 RETURN
3000 PRINT AT 10,11; FLASH 1; BR
IGHT 1;"GAME  OVER"
3005 PRINT AT 0,27;"    "
3010 FOR n=0 TO 500: NEXT n
3050 IF s>h3 THEN GO SUB 5000
3100 CLS : GO SUB 5611
3500 LET lives=lives-1
3510 FOR n=40 TO 10 STEP -3: BEE
P .2,n: NEXT n
3515 IF lives=0 THEN GO TO 3000
3520 INK 2: GO SUB 1000: INK 1
3530 PRINT AT 0,28;"    ": GO TO
11
4000 CLS : PRINT AT 10,7;"* S N
A K M A N *";AT 12,11;"
"
4005 RESTORE 4100
4010 FOR n=1 TO 13: READ a,b: BE
EP a,b: NEXT n
4050 RETURN
4100 DATA .3,1,.1,1,.3,1,.1,1,.1
,1,.2,3,.4,4,.2,3,.1,3,.1,3,.1,3
,.2,4,.3,6
5000 BORDER 3: PAPER 5: INK 0: L
ET y=6: LET x=0: CLS : PRINT AT
12,10;"HIGH  SCORE"
5001 PRINT AT 5,0;"A B C D E F G
 H I J K L M N O P";AT 7,0;"Q R
S T U V W X Y Z * # ( ) ! . ";AT
9,0;"£ : & = + - / \ ? $ < > ©
 END"
5002 LET n$=""
5003 LET r$="  "
5005 PRINT AT 15,1;"
* *
 *  SNAKMAN  * *
* *            *  *"
5010 PRINT AT y,x;"♥"
5015 LET a=y: LET b=x
5020 LET x=x+2*(INKEY$="8")-2*(I
NKEY$="5")
5021 IF x<0 AND y=6 THEN LET X=0
5022 IF x>30 AND y=6 THEN LET x=
0: LET y=y+2
5023 IF x>30 AND y=8 THEN LET x=
0: LET y=y+2
5025 IF x<0 AND y=8 THEN LET x=3
0: LET y=y-2
5026 IF x<0 AND y=10 THEN LET x=
30: LET y=y-2
5028 IF y=10 AND x>=28 THEN GO T
O 5201
5030 IF INKEY$="7" AND LEN n$<10
 THEN LET a$=SCREEN$ (y-1,x): LE
T n$=n$+a$: FOR n=30 TO 0 STEP -
3: BEEP .01,n: NEXT n
5040 PRINT AT 0,10;n$
5050 PAUSE 5
5190 PRINT AT a,b;" "
5200 GO TO 5010
5300 IF s>hi THEN LET h3=h2: LET
 h2=hi: LET hi=s: LET j$=i$: LET
 i$=h$: LET h$=n$: GO TO 5400
5310 IF s>h2 THEN LET h3=h2: LET
 h2=s: LET j$=i$: LET i$=n$: GO
TO 5400
5320 IF s>h3 THEN LET h3=s: LET
j$=n$: GO TO 5400
5500 CLS : PRINT INK 2;AT 10,0;"
 1   ";hi;AT 10,15;h$
5505 PRINT INK 1;AT 12,0;" 2
";h2;AT 12,15;i$
5510 PRINT INK 1;AT 14,0;" 3
";h3;AT 14,15;j$
5520 PAPER 5: PRINT INK 0;AT 5,1
0;"SCORE TABLE";AT 7,0;"RANK";AT
 7,5;"SCORE";AT 7,15;"NAME"
5550 FOR n=0 TO 100: NEXT n
5600 PRINT AT 21,5;"press any ke
y to play !"
5605 FOR n=1 TO 200
5610 IF IN 65278<>255 OR IN 3276
6<>255 OR INKEY$<>"" THEN GO TO
5612
5611 NEXT n: CLS : PRINT AT 10,1
0;"S N A K M A N";AT 12,16;"BY";
AT 14,9;"BURDON COMPUTERS";AT 16
,14;"© 1983": GO SUB 6000: GO TO
 5500
5650 GO TO 5
6010 RESTORE 6050
6020 FOR n=1 TO 20
6030 READ a,b: BEEP a,b: NEXT n
6050 DATA .2,0,.1,5,.1,5,.2,0,.2
,5
6055 DATA .2,1,.1,6,.1,6,.2,1,.2
,5
6060 DATA .2,0,.1,5,.1,5,.2,0,.2
,5
6065 DATA .1,1,.1,2,.1,3,.1,4,.1
,5
6100 RETURN
6110 RESTORE 6150: FOR n=1 TO 12
6120 READ a: BEEP .2,a: NEXT n
6130 RETURN
6150 DATA 0,0,4,12,11,9,-1,-1,2,
11,9,7
9000 RESTORE 9500: FOR z=1 TO 7
9005 READ z$
9010 FOR n=0 TO 7: READ a: POKE
USR z$+n,a: NEXT n
9020 NEXT z
9100 RETURN
9500 DATA "a",60,126,255,255,255
,255,126,60
9510 DATA "b",0,24,60,60,60,60,2
4,0
9520 DATA "e",14,55,248,240,248,
254,126,28
9530 DATA "c",112,236,31,15,31,2
55,124,56
9540 DATA "f",24,60,126,255,248,
227,98,34
9550 DATA "d",68,70,199,175,255,
126,60,24
9560 DATA "g",0,4,8,60,126,126,6
0,24
```

Life

Andrew Dilley,
Witley,
Surrey.

VIC-20

THIS LIFE program is fast, uses nearly all the screen, makes good use of colour graphics, and has a bit of sound thrown in.

The emphasis is definitely on fast, as the main fascination of Life is the constantly changing patterns. Since Basic is far too slow to do this, I have used some machine-code to control the birth-death logic and to display the cells. Unfortunately, because of the way screen memory moves about in the Vic when more than 3K of extra RAM is fitted, those lucky Vic owners will need to down-grade their machines to use the machine code.

The machine code is really quite straightforward. It looks at each character space in the display in turn. It then counts up how many "live" cells surround the space it is currently examining, and, depending on the rules of Life, it marks that space as either live or dead. It does this by changing that space's colour.

When it has done this for the whole display, it goes through it again. This time, wherever it finds the colour that corresponds to a live cell, it puts in a cell character. Otherwise, it puts in a space.

Because the program uses colour to distinguish between live and dying cells, some really interesting effects can be obtained depending on the choice of colours. To allow as much freedom as possible I have included multi-colour mode colours, which can be used for the dying cell colour. The colours used in the multi-colour graphics depend to some extent on the colour selected for the live cells.

The initial pattern of cells can either be randomly produced by the computer, or set by the user, using either the keyboard or a joystick.

When the colony of cells either becomes stable or dies the program will tell you how many generations of cells it took, and allow you to either rerun the program or end.

```
10 TC=7680:CO=30720
20 KB=197:PA=37137:PB=37152:DD=37154
30 POKE37139,0
100 GOSUB1000
110 GOSUB2000
120 G=0:N=128:D=2:PRINT"■■ HIT 'F1' TO STOP  "
130 POKE36876,N:SYS828:POKE36876,0
140 N=N+D:IFN=128ORN=252THEND=-D
150 IFPEEK(0)>0THEN200
160 IFPEEK(KB)=39THEN210
170 G=G+1:GOTO130
197 REM--------------
198 REM    END
199 REM--------------
200 PRINT"■■■■■■■■■■■■■■■■■■■■■■STOPPED AFTER"G"GOS"CHR$(157)CHR$(148)"E";
210 PRINT"■■■R■E-RUN OR ■E■ND ?  "
220 GOSUB3000
230 IFA$="R"THEN110
240 IFA$<>"E"THEN220
250 POKE36879,27:PRINT"■■■HOPE YOU ENJOYED IT":END
997 REM--------------
998 REM   TITLE
999 REM--------------
1000 POKE36879,44
1010 PRINT"■■"TAB(7)"■L I F E":PRINTTAB(6)"■---------"
1020 PRINT"■■■■  A VERSION OF THE    ■CLASSIC COMPUTER GAME    ■■■BY ANDREW DIL
LEY"
1030 PRINT"■■■■ LOADING MACHINE CODE":PRINTTAB(5)"■PLEASE WAIT"
1040 GOSUB5000
1050 PRINT"■    ■■R E A D Y ■    "
1060 PRINT"■■■ HIT ANY KEY TO START"
1070 GOSUB3000:RETURN
1497 REM--------------
1498 REM INSTRUCTIONS
1499 REM--------------
1500 PRINT"■■■  USE THESE KEYS TO    POSITION THE CELLS"
1510 PRINTTAB(10)"■■UP■■■I■■■S":PRINTTAB(4)"■■LEFT-■< >■-RIGHT":PRINTTAB(10)"■■
■Idown"
1520 PRINT"■ ■SPACE-BAR ■FOR CELL"
1530 PRINT"■■(OR USE A JOY-STICK)"
1540 PRINT"■    ■■ HIT ANY KEY "
1550 GOSUB3000:RETURN
1997 REM--------------
1998 REM  START
1999 REM--------------
2000 PRINT"■":FORI=0TO7:POKE646,I:PRINT" ●";:NEXT:PRINT
2010 PRINT"■■LIVE CELL COLOUR"
2020 INPUT"(1-8)";LC:IFLC<1ORLC>8THENPRINT"■■":GOTO2020
2030 LC=LC-1:POKE36878,15OR16*LC:POKE646,LC:PRINTTAB(11)"●■■"
2040 FORI=0TO15:POKE646,I:PRINT" ●";:NEXT:PRINT
2050 PRINT"■■'DYING' CELL COLOUR"
2060 INPUT"(1-16)";DC:IFDC<1ORDC>16ORDC-1=LCTHENPRINT"■■":GOTO2060
2065 DC=DC-1:POKE646,DC:PRINTTAB(11)"●"
2070 PRINT"■■■■OK (Y/N)?":GOSUB3000
2080 IFA$<>"Y"THEN2000
2090 POKE871,LC:POKE903,LC:POKE867,DC
2100 PRINT"■■■P■OSITION CELLS":PRINTTAB(5)"■■OR":PRINT"■■■R■ANDOM ?"
2110 GOSUB3000
2120 IFA$="P"THENGOSUB2500:RETURN
2130 IFA$="R"THENGOSUB2800:RETURN
2140 GOTO2110
2497 REM--------------
2498 REM  POSITION
2499 REM--------------
2500 PRINT"■■■ INSTRUCTIONS ■(Y/N)?":GOSUB3000
2510 IFA$="Y"THENGOSUB1500
2520 PRINT"■■ 'F7' WHEN FINISHED":POKE198,0:X=1:Y=1
2530 P=TC+22*Y+X:U=PEEK(P):UC=PEEK(CO+P)
2535 POKEP,128+U:POKECO+P,1
2540 K=PEEK(KB):J1=PEEK(PA):POKEDD,127:J2=PEEK(PB):POKEDD,255
2550 IFK=63THENPOKEP,U:POKECO+P,UC:RETURN
2560 IFK=32OR(J1AND32)=0THENU=81:UC=LC:GOTO2535
2570 NX=X+(K=29OR(J1AND16)=0)-(K=37OR(J2AND128)=0)
2580 NY=Y+(K=41OR(J1AND4)=0)-(K=26OR(J1AND8)=0)
2590 IFNX=XANDNY=YORNX<1ORNX>20ORNY<1ORNY>21THEN2540
2600 POKEP,U:POKECO+P,UC
2620 X=NX:Y=NY:GOTO2530
2797 REM--------------
2798 REM  RANDOM
2799 REM--------------
2800 PRINT"■"
2810 FORY=1TO21:FORX=1TO20
```

(continued on page 183)

(continued from page 181)

```
2820 IFRND(1)<.2THENP=TC+22*Y+X:POKECO+P,LC:POKEP,81
2830 NEXT:NEXT
2840 RETURN
3000 GETA$:IFA$=""THEN3000
3010 RETURN
4997 REM--------------
4998 REM CODE LOADER
4999 REM--------------
5000 I=828
5010 READH$:IFH$="*"THEN5050
5020 H=ASC(H$)-48:L=ASC(RIGHT$(H$,1))-48
5030 H=H+7*(H>9):L=L+7*(L>9)
5040 POKEI,16*H+L:I=I+1:GOTO5010
5050 FORJ=0TO7:READX:POKE675+J,X:NEXT
5060 RETURN
5100 DATA A9,17,85,01,85,FB,A9,1E,85,02,A9,96,85,FC,85,00,A9,00,8D,A1,02,8D,A2,
02,A8
5110 DATA 20,A3,03,A6,FD,E0,03,F0,08,E0,02,F0,06
5120 DATA A9,00,10,02,A9,00,91,FB,20,CC,03,AD,A2,02,C9,15,D0,E1
5130 DATA A9,17,85,01,85,FB,A9,1E,85,02,A9,96,85,FC
5140 DATA B1,FB,29,0F,C9,00,F0,04,A9,20,D0,02,A9,51,D1,01,F0,02,84,00,91,01,20,
CC,03
5150 DATA AD,A2,02,C9,2A,D0,E0,60
5160 DATA 38,A5,01,E9,17,85,FE,A5,02,E9,00,85,FF
5170 DATA A2,07,84,FD,BD,A3,02,18,65,FE,85,FE,90,02,E6,FF,B1,FE
5180 DATA C9,51,D0,02,E6,FD,CA,10,E9,60
5190 DATA AE,A1,02,E8,E0,14,D0,14,A2,00,EE,A2,02,18,A5,01,69,02,90,04,E6,02,E6,
FC
5200 DATA 85,01,85,FB,8E,A1,02,E6,01,E6,FB,D0,04,E6,02,E6,FC,60,*
5300 DATA 1,1,20,2,20,1,1,0
```

Function graphs

Billy Wain,
Heckmondwike,
West Yorkshire.



THE PROGRAM occupies about 2.5K of memory. The program itself plots any graph between specified points in mode 0. By plotting the axes and choosing a suitable scale, a good graph is obtained. Points are calculated before plotting them, ensuring maximum speed when plotting. By pressing any of the function keys — 0 to 7 — example plots have been entered for the inexperienced. Scaling for the axes was done by the simple expedient of taking logs between maximum and minimum values.

```
10 REM ... FUNCTION GRAPHS ...
20 REM ... By B.Wain BUSc. ...
30 REM . Example plots on red keys .
40 *KEY 0 SIN(X) !M 0 !M 6.28 !M 0.02 !M
50 *KEY 1 X^2 !M -10 !M 10 !M 0.1 !M
60 *KEY 2 X^3 !M -10 !M 10 !M 0.1 !M
70 *KEY 3 1/X !M 0 !M 10 !M 0.1 !M
80 *KEY 4 LOG(X) !M 0.1 !M 10 !M 0.1 !M
90 *KEY 5 1+2*COS(X)+COS(2*X) !M -6.28 !M 6.28 !M 0.04 !M
100 *KEY 6 COS(X)^2 !M 0 !M 6.28 !M 0.02 !M
110 *KEY 9 DEL.30,150!MRUN!M
120 MODE 7
130 VDU 23;8202;0;0;0;
140 PRINT TAB(9,12);CHR$(130);CHR$(136);"Press f9 to run"
150 VDU 21:STOP
160 VDU 6
170 ON ERROR GOTO 950
180 MODE 1
190 VDU 19,0,4;0;17,3,12
200 PRINT
210 PRINT TAB(12)"Function Graphs"
220 PRINT TAB(12)STRING$(15,"_")
230 VDU 28,2,30,37,4,17,129,12,17,3
240 PRINT''"  Enter the function of the graph."
250 PRINT
260 PRINT "  Write it in terms of x as shown."
270 PRINT
280 PRINT "     e.g.  Y=(X^2+2)^2"
290 PRINT
300 PRINT"  Then press 'RETURN' to continue"
310 PRINT
320 PRINT "  (Press f0-f6 for example plots)"
330 PRINT
340 INPUT TAB(5)"Y="F$
350 IF F$="":VDU11:PRINT SPC(40):VDU11,11:GOTO 340
360 PRINT
370 PRINT TAB(3)"Input the range of x-values"
380 INPUT'TAB(10)"From x="V1
390 INPUT'TAB(10)"  To x="V2
400 IF V2-V1<=0 THEN VDU 28,2,30,37,16,12,28,2,30,37,4:GOTO 370
410 INPUT'TAB(10)"in steps of "step
420 IF V2-step<V1 OR step=0 PRINT TAB(0,18);STRING$(40," "):PRINT TAB(0,17);:G
OTO 410
430 IF (V2-V1)/step>640 @%=10:PRINT '"With a step value of ";step;",there are"
'" too many points to plot."'"Input a larger step value.":step=0:@%=&02010A:GOTO
 420
440 PRINT''''" PRESS ESCAPE TO RERUN THE PROGRAM"
450 A$=INKEY$(100)
460 NP=INT((V2-V1)/step)+1
470 @%=&02010A
480 DIM X(NP),Y(NP),Z(9)
490 FOR R%=1 TO 9:READ Z(R%):NEXT
500 X=V1:Y(0)=0:Y1=0:Y2=1:M=0:N=0
510 X%=1
520 X(X%)=X:Y(X%)=EVAL(F$)
530 IF Y(X%)>6000 Y(X%)=6000
540 IF Y(X%)<-6000 Y(X%)=-6000
550 IF Y(X%)>Y2 Y2=Y(X%) ELSE IF Y(X%)<Y1 Y1=Y(X%)
560 X%=X%+1:X=X+step
570 IF X>V2 THEN 580 ELSE 520
580 X%=X%-1:SX=1200/(V2-V1)
590 OX%=ABS(V1*SX)
600 SY=1024/(Y2-Y1)
610 OY%=ABS(Y1*SY)
620 IF OY%>64 Q%=0 ELSE Q%=64
630 IF OX%>86 P%=0 ELSE P%=86
640 VDU 22,0,5
650 VDU 29,OX%+P%;OY%+Q%;
660 MOVE 0,1024
670 DRAW 0,-1024
680 MOVE -1280,0:DRAW 1280,0
690 PROCSCALE(V2,V1)
700 REPEAT M=M+1
710 step=Z(M)*Y
720 UNTIL step*SX>=64 OR M=9
730 FOR X=V1 TO V2+step STEP step
740 MOVE X*SX,0:DRAW X*SX,-10
750 MOVE X*SX-8,-20:PRINT;X
760 NEXT
770 PROCSCALE(Y1,Y2)
780 REPEAT N=N+1
790 ystep=Z(N)*Y
800 UNTIL SY*ystep>=64 OR N=9
810 FOR Y=Y1 TO Y2+ystep STEP ystep
820 MOVE 0,Y*SY:DRAW -10,Y*SY
830 MOVE -64,Y*SY+8:PRINT;Y
840 NEXT
850 MOVE 0,Y*SY:DRAW -10,Y*SY
860 X=1:REPEAT
870 PLOT 70,X(X)*SX,Y(X)*SY
880 X=X+1:UNTIL X>X%
890 GOTO 890
900 DEF PROCSCALE(P,Q)
910 Y=LOG(ABS(P-Q))
920 IF Y>=.5 Y=INT(Y+0.5):ENDPROC
930 Y=10^(INT(Y))
940 ENDPROC
950 REM ... ERRORS ..
960 IF ERR=17 RUN
970 IF ERR=18 AND X%=1 X=X+step:GOTO 510
980 IF ERR=18 step=step+(step/1.5):X=V1-step:GOTO 510
990 IF ERR=22 X=X+step:Y(X%)=6000:GOTO 560
1000 IF ERR=20 Y(X%)=6000:GOTO 560
1010 REPORT:PRINT " at line ";ERL:END
1020 ENDPROC
1030 DATA .1,.2,.5,1,2,5,10,20,50
```

Quick change

Mark Lowe,
Berkswell,
West Midlands.



USUALLY TO change the colour of the Paper, Ink, Bright and Flash you have to clear the screen on a 16K Spectrum. When this program is executed it changes the Paper, Ink, Bright and Flash immediately.

To use the program you have to first load the loader supplied on the sheet and run it. Once the machine code is in memory you can delete the loader and type in your program. here is an example program:

```
10 FOR N = 1 TO 50: LET A = INT (RND*255):
   LET B = INT (RND*175)
20 PLOT A,B: DRAW 255-A: PLOT A,B:
   DRAW 0-A, 0-B
30 NEXT N
40 FOR N = 1 TO 255:PAUSE 50: POKE 32254,N
50 RANDOMISE USR 32250: NEXT N
```

All of the code has been adapted from a list of instructions printed in Kathleen Peel's machine-code article, in August *Your Computer*. The code is only 25 bytes long so it will not take very long to enter.

```
10 CLEAR 32249
20 FOR A=0 TO 24
30 READ B: POKE 32250+A,B:NEXT A
40 DATA 33,0,88,6,0,22,3,14,255,112
50 DATA 35,13,32,251,21,32,247,14,2
60 DATA 112,35,13,32,251,201

TO USE:

POKE 32254,ATTR

POKE THE ATTRIBUTE INTO LOCATION
32254 THEN TO EXECUTE TYPE:

RANDOMIZE USR 32250

CODE         MNEMONICS

33 0 88      LD HL
6 0          (22528)
22 3         LD B(ATTR)
14 255       LD D,3
112          LD C,255
35           LD HL(B)
13           INC HL
32 251       DEC C
21           JR NZ,-5
32 247       DEC D
14 2         JR NZ,-9
112          LD C,2
35           LD HL(B)
13           INC HL
32 251       DEC D
201          JR NZ,-5
             RET TO
             BASIC
```

Writing aids

Julian Wood,
Downham Market,
Norfolk.

ZX-81

THE FOLLOWING machine-code routines are a great aid to the Basic programmer writing and developing programs. The explanation of how to enter and use each routine refers to the listings of the relevant Basic program which Pokes the machine code into memory.

First a Line Block Delete: Enter a line 1

(continued on page 187)

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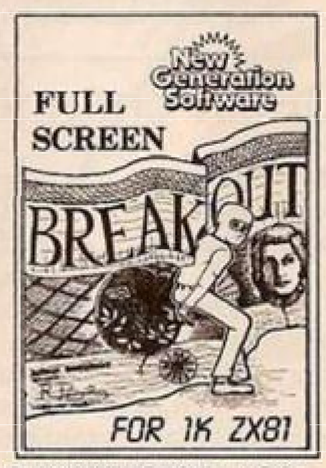
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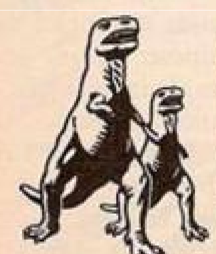


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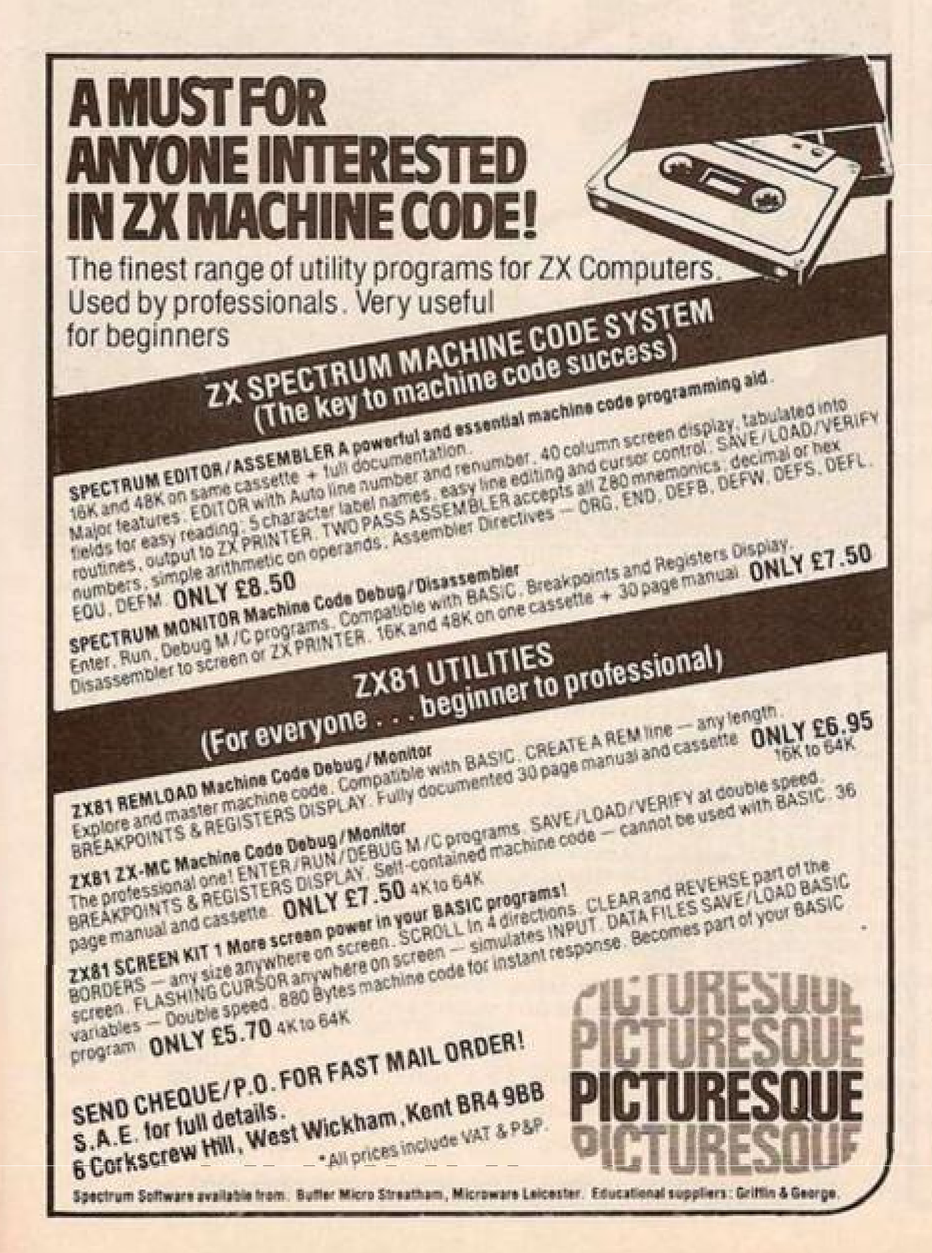
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(continued from page 183)

Rem followed by 96 characters and then

POKE 23756,0

which changes it to line 0, so it cannot be deleted. Enter the rest of the program and Run 10, and the routine will be Poked into line 0. To delete the now unwanted data, Run the program and enter 10 and then 77 for the inputs. If all is successful you should find that lines 10 to 77 have been deleted, leaving the delete program which can be Saved as a normal program.

Next, a Utilities program. Enter it and Run it, and the machine code will be Poked in above RAMtop, and can be saved using

SAVE "util" CODE 32416,183

When loading back, it is necessary to Clear 32415 beforehand. The subroutines are as follows:

ATTR CHANGE

To use this, you simply have to use the normal Basic colour commands and then Rand Usr 32416. For example:

FOR a=32 TO 255:PRINT CHR$ a;:NEXT a:PAPER 1:INK 6:FLASH 1:RAND USR 32416

prints the character set, and then sets the whole screen flashing with blue paper and yellow ink without clearing the screen.

SEARCH AND REPLACE

Replaces any specified character with another character. Poke 32435 with the search character code and 32437 with the replace character code. For example, to change all the Print commands to LPrint:

POKE 32435,245:POKE 32437,224:
RAND USR 32434

The next Utilities subroutine is

SCREENS

This differs from the one in ROM as it works with the predefined graphics and the user defined graphics, as well as the normal ASCII characters. To use it, Print At the position on the screen you wish to check and call the routine. For example:

PRINT AT 10,10;:LET L=USR 32477

will give the code of the character at position 10,10. If there is no such character, then L will equal zero.

```
   0>REM aaaaaaaaaaaaaaaaaaaaaaaa
aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
aaaaaaaaa
   1 INPUT "From ";s;" to ";f: I
F f<s OR s<1 OR s>9999 OR f<1 OR
 f>9999 THEN GO TO 1
   2 POKE 23729,INT (s/256): POK
E 23728,s-256*PEEK 23729: RANDOM
IZE f: RANDOMIZE USR 23760
  10 LET l=95
  15 FOR a=23760 TO 23760+l
  20 READ b: POKE a,b: NEXT a
  50 DATA 237,75,176,92,205,14,9
3,229,237,75,118,92,205,14,93
  55 DATA 35,35,94,35,86,25,35
  60 DATA 209,167,237,82,229,25,
235,229,42,101,92,167,237,82
  70 DATA 68,77,225,235,237,176,
42,75,92,209,167,237,82,34,75,92
  75 DATA 42,89,92,167,237,82,34
,89,92,201
  76 DATA 42,83,92,86,35,94,235,
167,237,66,9,235,40,18,35,94,35,
86
  77 DATA 35,25,237,91,75,92,167
,237,82,25,56,229,207,10,43,201

   5 CLEAR 32415
```

```
  10 FOR a=32416 TO 32599: READ
b: POKE a,b: NEXT a
  50 REM ATTR change
  60 DATA 33,0,88,1,192,90,58,14
1,92,119,35,167;237,66,9,32,248,
201
 100 REM search+replace
 110 DATA 22,0,30,0,42,83,92,35,
35,35,35,126,14,14,185,32,3,35,2
4,243
 120 DATA 14,13,185,32,12,35,237
,75,75,92,167,237,66,9,208,24,22
6,185,32,226,115,24,223
 125 REM SCREEN$
 130 DATA 42,54,92,36,17,128,32,
205,27,127,20,30,144,33,58,127,2
13,237,91
 140 DATA 132,92,14,2,6,4,26,190
,32,12,20,16,-7,35,13,32,-13
 150 DATA 209,6,0,74,201,6,0,9,2
09,20,123,186,32,-34,42,123,92,3
0,165,205,27,127,1,0,0,201
 160 DATA 1,8,0,213,237,91,132,9
2,26,20,190,32,10,35,13,32,-9
 170 DATA 209,6,0,74,209,201,9,2
09,20,123,186,32,-30,201
 180 DATA 15,0,240,0,255,0,0,15,
15,15,240,15,255,15,0,240,15,240
,240,240,255,240,0,255,15,255,24
0,255,255,255
```

Matrix mover

K J Gouldstone,
Wallington,
Surrey.

ZX-81

THIS PROGRAM simulates some of VisiCalc's facilities on the ZX-81. The size of the matrix in this program is 19 by 4; however this could be extended.

Upper-case number keys are used to control all functions. Shift 1 will print the screen, Shift 2 will save the program and Data on tape, Shift 5, 6, 7 and 8 will move the cursor, shift 9 will let you enter a formula and shift 0 will recalculate all figures.

Each location on the matrix is given a number and a letter for example, 10A. You may enter either a number of a description in each location. Simply move the cursor to the required location and enter a value, then press Newline.

In you press Shift 9 you may enter a formula for the location. The current location should equal the value in location 04C plus the value in location 05C, enter 04C + 05C with no spaces, and press Newline. This formula is now associated with that location. Enter Shift 0 and all values will be calculated using the formulas entered.

You may enter up to eight locations in a formula and may use plus, minus, oblique and asterisk. Formulas for each location are displayed automatically when moving the cursor. The A$ array holds the values and the B$ array holds all formulas. All input to the program is by use of the Inkey$ function. The program will run automatically when loaded.

```
   1 DIM A$(19,4,7)
   2 DIM B$(19,4,31)
   9 STOP
  10 SLOW
  11 PRINT AT 0,23;"[illegible]"
  12 DIM D$(7)
  15 PRINT AT 2,0;"[illegible]"
  20 FOR A=1 TO 19
  21 IF A<10 THEN PRINT AT A+2,0
;"0";A;
  22 IF A>9 THEN PRINT AT A+2,0;
A;
  25 FOR B=1 TO 4
  30 PRINT AT A+2,(B*7)-4;A$(A,B
);
  35 NEXT B
  40 NEXT A
  45 GOSUB 4000
  50 LET C=1
  60 LET R=1
  70 LET M$=INKEY$
  80 IF M$="" THEN GOTO 70
  85 LET OR=R
  86 LET OC=C
  90 IF CODE M$=112 THEN LET R=R
-1
 100 IF CODE M$=113 THEN LET R=R
+1
 110 IF CODE M$=114 THEN LET C=C
-1
 120 IF CODE M$=115 THEN LET C=C
+1
 125 IF CODE M$<112 OR CODE M$>1
15 THEN GOTO 300
 130 IF R>19 THEN LET R=1
 140 IF R<1 THEN LET R=19
 150 IF C>4 THEN LET C=1
 160 IF C<1 THEN LET C=4
 200 LET D$=CHR$ (CODE A$(R,C,1)
+128)+CHR$ (CODE A$(R,C,2)+128)+
CHR$ (CODE A$(R,C,3)+128)+CHR$ (
CODE A$(R,C,4)+128)+CHR$ (CODE A
$(R,C,5)+128)+CHR$ (CODE A$(R,C,
6)+128)+CHR$ (CODE A$(R,C,7)+128
)
 205 PRINT AT OR+2,(OC*7)-4;A$(O
R,OC)
 210 PRINT AT R+2,(C*7)-4;D$
 220 PRINT AT 1,0;B$(R,C)
 230 GOTO 70
 300 IF CODE M$=116 THEN GOTO 37
0
 301 IF CODE M$=119 THEN GOTO 10
05
 302 IF CODE M$=117 THEN GOTO 20
00
 303 IF CODE M$=218 THEN GOTO 30
00
 304 IF CODE M$=223 THEN GOTO 10
00
 305 IF CODE M$=118 THEN GOTO 70
 306 LET A$(R,C)="       "
 307 PRINT AT R+2,(C*7)-4,"[illegible]"
 310 FOR A=1 TO 7
 313 IF CODE M$>111 AND CODE M$<
116 THEN GOTO 85
 315 IF CODE M$=118 THEN GOTO 70
 316 IF CODE M$=26 THEN LET M$="
"
 320 LET A$(R,C,A)=M$
 330 PRINT AT R+2,(C*7)-5+A;CHR$
(CODE A$(R,C,A)+128)
 340 LET M$=INKEY$
 345 IF M$="" THEN GOTO 340
 350 NEXT A
 360 GOTO 70
 370 PRINT AT 0,0;"ENTER FORMULA
"
 376 PRINT AT 1,0;"
"
 377 LET B$(R,C)="
"
 380 FOR A=1 TO 31
 385 LET M$=INKEY$
 386 IF M$="" THEN GOTO 385
 387 IF CODE M$=26 THEN LET M$="
"
 400 IF CODE M$=118 THEN GOTO 47
0
 420 LET B$(R,C,A)=M$
 430 PRINT AT 1,A-1;B$(R,C,A)
 460 NEXT A
 470 PRINT AT 0,0;"
"
```

(continued on page 189)



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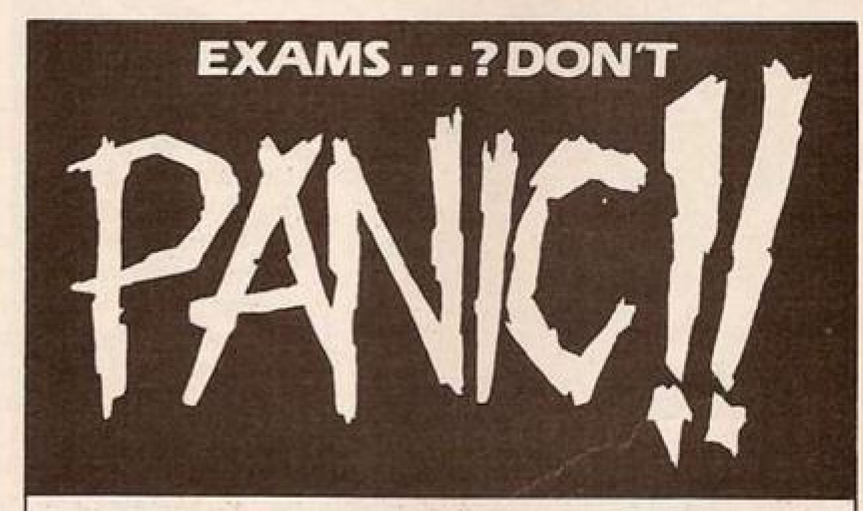
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(continued from page 187)

```
 480 GOTO 70
1000 FAST
1005 PRINT AT 0,0;"RECALCULATING
 - "
1009 FOR A=1 TO 19
1010 PRINT AT 0,16;A
1015 FOR B=1 TO 4
1020 IF B$(A,B)="
                  " THEN GOTO 1300
1021 LET S=0
1022 LET A$(A,B)=STR$ S
1025 LET U=0
1030 LET L=21
1035 GOTO 1080
1070 LET L=CODE B$(A,B,U)
1080 LET J=VAL B$(A,B,U+1 TO U+2
)
1090 LET K=CODE B$(A,B,U+3)-37
1100 IF CODE A$(J,K)<26 OR CODE
A$(J,K)>37 THEN GOTO 1275
1230 IF L=21 THEN LET S=VAL A$(A
,B)+VAL A$(J,K)
1240 IF L=22 THEN LET S=VAL A$(A
,B)-VAL A$(J,K)
1250 IF L=23 THEN LET S=VAL A$(A
,B)*VAL A$(J,K)
1260 IF L=24 THEN LET S=VAL A$(A
,B)/VAL A$(J,K)
1270 LET A$(A,B)=STR$ S
1275 LET U=U+4
1277 IF U=32 THEN GOTO 1280
1278 IF B$(A,B,U)<>" " THEN GOTO
 1070
1280 PRINT AT A+2,(B*7)-4;"
 "
1290 PRINT AT A+2,(B*7)-4;A$(A,B
)
1300 NEXT B
1310 NEXT A
1315 SLOW
1320 PRINT AT 0,0;"
 "
1330 GOTO 70
2000 COPY
2010 GOTO 70
3000 CLS
3010 PRINT AT 5,0;"SET TO RECORD
 THEN PRESS N/L"
3020 INPUT U$
3030 SAVE "X"
3040 CLS
3050 GOTO 10
4000 REM MESSAGE
4010 LET K$="1=PRINT/2=SAVE/3=FO
RMULA/4=CALC"
4020 LET X=PEEK 16396+256*PEEK 1
6397
4030 FOR N=760 TO 759+LEN K$
4040 LET Y=CODE K$(N-759)
4050 POKE N+X,Y
4060 NEXT N
4070 RETURN
```

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B D D'Silva,
London SW19.



THE LYNX PROVIDES some useful Basic debugging facilities such as Trace and Speed but lacks the facility, which some computers have, to dump. With it, all the variables and their values are printed and also the dimensions of array and strings.

The first of the three machine-code programs prints out the ordinary variables and their values. The second prints out the dimensions of numerical arrays and the third prints out the lengths of the strings.

All three programs are relocatable therefore they can be located in Basic in a Code line and Run using

CALL LCTN (line number)

but this is not very satisfactory since all three programs strung one after the other are too long to type in through Basic. The way round this would be to type in the lowest line number as a Rem line with the line full with any characters. Then go into MON and modify the 23 at 6953, which is the Rem token, to 33. Note these are Hex values. Number 33 is the token of Code. LCTN — lowest line number — gives 6945H, so modify address 6945 onwards with the programs.

A much better way to locate the programs is through MON and locate it high up in memory eg 9C40H which is 4E4 in decimal. EXT does a call to &6224 thus DPOKE &6225, Start address of code will give extensions to Basic.

```
PROGRAM 1 - PRINT VARIABLES

2A 0F 62 START:   LD HL,(620FH);location of
06 35             LD B,35H      ;variables
23       NXTONE:  INC HL
7E                LD A,(HL)
2B                DEC HL
FE FF             CP FFH
28 1D             JR Z,NXTVAR
3E 75             LD A,75H
90                SUB B
FE 5B             CP 5BH
38 02             JR C,UPVAR
C6 06             ADD A,6
CF       UPVAR:   RST 8         ;VDU A
3E 3D             LD A,3DH
CF                RST 8
CD 2A 35          CALL 352AH  ;PRINT SPACE
C5                PUSH BC
E5                PUSH HL
CD B1 35          CALL 35B1H
CD 59 1D          CALL 1D59H
E1                POP HL
C1                POP BC
3E 09             LD A,9
CF                RST 8
11 05 00 NXTVAR:  LD DE,0005
19                ADD HL,DE
10 D6             DJNZ NXTONE
3E 0D             LD A,0DH
CF                RST 8
C9                RET        ;only if other
                             ;programs are
                             ;not attached
```

```
PROGRAM 2 - PRINT ARRAY DIMENSIONS

2A 11 62  START:   LD HL,(6211H)
06 35              LD B,35H
7E        NXTONE:  LD A,(HL)
23                 INC HL
B6                 OR (HL)
28 24              JR Z,NXTVAR
3E 75              LD A,75H
90                 SUB B
FE 5B              CP 5BH
38 02              JR C,UPVAR
C6 06              ADD A,6
CF        UPVAR:   RST 8
3E 28              LD A,28H
CF                 RST 8
23                 INC HL
5E                 LD E,(HL)
23                 INC HL
56                 LD D,(HL)
EB                 EX DE,HL
1B                 DEC DE
1B                 DEC DE
C5                 PUSH BC
D5                 PUSH DE
CD C4 34           CALL 34C4
CD 59 1D           CALL 1D59
E1                 POP HL
C1                 POP BC
3E 29              LD A,29H
CF                 RST 8
3E 09              LD A,9
CF                 RST 8
23        NEXTVAR: INC HL
23                 INC HL
23                 INC HL
10 D2              DJNZ NXTONE
3E 0D              LD A,0DH
CF                 RST 8
C9                 RET;only if other
                      ;programs are
                      ;not attached
```

```
PROGRAM 3 - PRINT LENGTH
        OF STRINGS

2A 13 62START:   LD HL,(6213H)
06 1A            LD B,1AH
7E       NXTONE: LD A,(HL)
5F               LD E,A
23               INC HL
56               LD D,(HL)
B6               OR (HL)
28 1E            JR Z,NXTVAR
3E 5B            LD A,5BH
90               SUB B
CF               RST 8
3E 24            LD A,24H
CF               RST 8
3E 28            LD A,28H
CF               RST 8
C5               PUSH BC
E5               PUSH HL
1A               LD A,(DE)
26 00            LD H,00
6F               LD L,A
CD C4 34         CALL 34C4
CD 59 1D         CALL 1D59
E1               POP HL
C1               POP BC
3E 29            LD A,29H
CF               RST 8
3E 09            LD A,9
CF               RST 8
23       NXTVAR: INC HL
23               INC HL
23               INC HL
10 D6            DJNZ NXTONE
3E 0D            LD A,0DH
CF               RST 8
C9               RET
```

Forth surround

A R Weaver,
Swindon,
Wiltshire.

THIS PROGRAM for the unexpanded Jupiter Ace is the legendary Surround program translated into Forth with sound and high-resolution graphics. Your task is to control the man who runs around the screen trying to avoid the randomly-produced blocks which appear next to him. You must avoid having to run into a block for as long as possible and the computer keeps count of how many times you have moved. My best is 207.

A hint: try to stay in one area as long as it is safe in order to fill up as much of that part of the screen as possible.

There are three variables : a, which is your position on the screen; s, which is used to produce the random numbers; and sc which keeps count of your moves.

The words ss and rnd produce a random number. Set draws a boundary around the screen; fin is the end of the game.

Mv moves your man around the screen and check to see if you have hit a block, bk prints a block randomly next to you on the screen. Go sets up the variable and uses a Begin-Until loop to continuously keep the game going until it reaches fin. Man stores the data for the character; game starts the game.

```
0 variable a 0 variable s 0 variable sc
: ss s @ 75 u* 75 0 d+ over over u<- - 1- dup s! ;
: rnd ss u* swap drop ;
: set cls 31 1 do 1 i at 160 emit 20 i at 160 emit
loop 21 1 do i 1 at 160 emit i 30 at 160 emit loop ;
: fin 20 200 do i 100 beep -10 +loop 10 1 do 1 a
@ c! 999 1 do loop 129 a @ c! 999 1 do loop loop
cls 10 10 at ." Score:" sc @ . abort;
: mv begin inkey dup 0= if drop 0 else 1 then
until 100 100 beep 32 a @ c! dup dup dup 53 = if
a @ 1- a! then 54 = if a @ 32 - a ! then 55 = if a
@ 32 + a ! then 56 if a @ 1+ a ! then a @ c@
160 = if fin then sc @ 1+ sc ! 1 a @ c! ;
: bk 4 rnd dup dup dup 0= if 160 a @ 1 + c! then
1 = if 160 a @ 1- c! then 2 = if 160 a @ 32 + c!
then 3 = if 160 a @ 32 - c! then 400 50 beep ;
: go 9550 a ! 0 sc ! set 1 a @ c! begin bk mv 2000
1 do loop 0 until ;
: gr 8 * 11263 + dup 8 + do i c! -1 + loop ;
: man 24 24 60 90 219 24 36 102 1 gr ;
: game man go ;
```

COMPETITION CORNER

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in March. The name of the winner, the solution, and a competition report will be published in the May, 1983 issue of *Your Computer.*

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

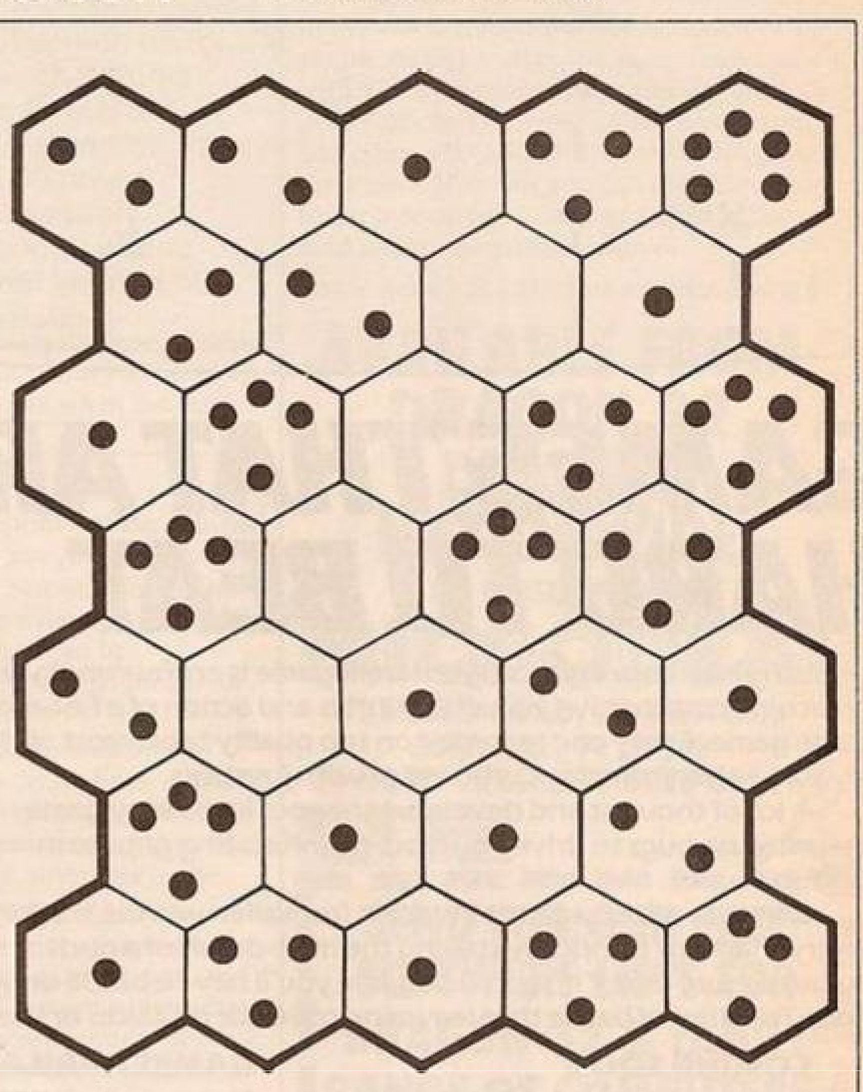
ANDROID MUTINY ON THE INTERGALACTIC HIVE-SHIP

BY ANTHONY ROBERTS

THE QUEEN of an intergalactic hive-ship has a problem: her number one android has just staggered into her control-pod bearing terrible hand-blaster damage — mutiny! She needs to know quickly the identity of its attacker, but has nothing more than the android's memory map of the numbered ID-badge of the assailant. Of course, she knows how the android was programmed to interpret this map in order to display the number. Here is the program. The first part reads the map, cell by cell and the second part interprets the map to produce a display for each cell. What is the number on the ID-badge?

The grid you see below right is the android's memory map. Below left is the program that interprets the map, and which will reveal the number on the ID badge.

```
10 DIM m(9,9)
15 FOR x=2 TO 8
20 FOR y=2 TO 6
30 READ m(x,y)
35 NEXT y: NEXT x
40 FOR x=2 TO 8
45 FOR y=2 TO 6
50 LET v=0
55 FOR a=x-1 TO x+1
60 FOR b=y-1 TO y
62 LET c=0
65 IF x=a AND y=b THEN LET b=b+1
66 IF x=a THEN GO TO 70
67 IF a=2*INT (x/2) THEN LET c=1
68 IF a=2+2*INT (x/2) THEN LET c=1
70 LET v=v+m(a,b+c)
80 NEXT b: NEXT a
90 LET t=0
100 LET a=INT (v/2): LET t=t+(v-(2*a))
110 IF a>0 THEN LET v=a: GO TO 100
120 IF t=2 THEN PRINT AT x,y;"■"
130 NEXT y: NEXT x
150 DATA 2,2,1,3,5,3,2,0,1,0,1,4,0,3,4,4,0,4,3,0,2,0,1,2,1,4,1,1,2,0,1,3,1,3,4
```



Competition results

BILL BENNETT'S review of the Texet TX-8000 was not overly enthusiastic which perhaps explains why the offer of a Texet as a prize in our April competition drew only a lukewarm response. Many of the entries were rather disparaging.

J Morgan suggested the machine should have been called "Hong Kong Phooey" while P Smith proposed "the Orid-1". "No Tex please, we're British", cried T Anderson and least flattering of all was D Duffy's "the Hong Kong Haemorrhoid — latest attack on the bottom of the market".

Some entries damned the Hong Kong micro with faint praise. A Mitton offered "The OK 4K in the U.K. from HK" and from D Lockwood came "Venus — it's a bit blurred, comes from the East and not really a star".

A Pearce was a little kinder to the Texet with "Fire Cracker — they've jumped out of the pan and taken the biscuit" and J Metcalfe's "Our kid — it is small, colourful and internally complicated" was almost affectionate.

The Texet Poppy, the Sporcitron, the Wonder Wok, the Mutant, Bill or George, the Paragon, the Comic, the Phoenix — these were some of the other names suggested for the prize.

the solution to the April crossword.

	A				H				D		R		P	
D	R	A	G	O	O	N		C	O	N	I	C	A	L
	C		U		B				L		G		C	
E	A	R	L	O	B	E		A	L	C	H	E	M	Y
	D		P		I				A		T		A	
	E	A	S	Y	T	O	T	U	R	N		E	N	D
					A				C					
A	D	D			D	U	T	C	H			E	S	P
	U		C		V				A		U		C	
I	N	V	A	D	E	R		G	R	A	P	H	I	C
	G		R		N				A		S		S	
S	E	C	R	E	T	E		E	C	S	T	A	S	Y
	O		Y		U				T		A		O	
I	N	D	O	O	R	S		L	E	T	T	E	R	S
	S		N		E				R		E		S	

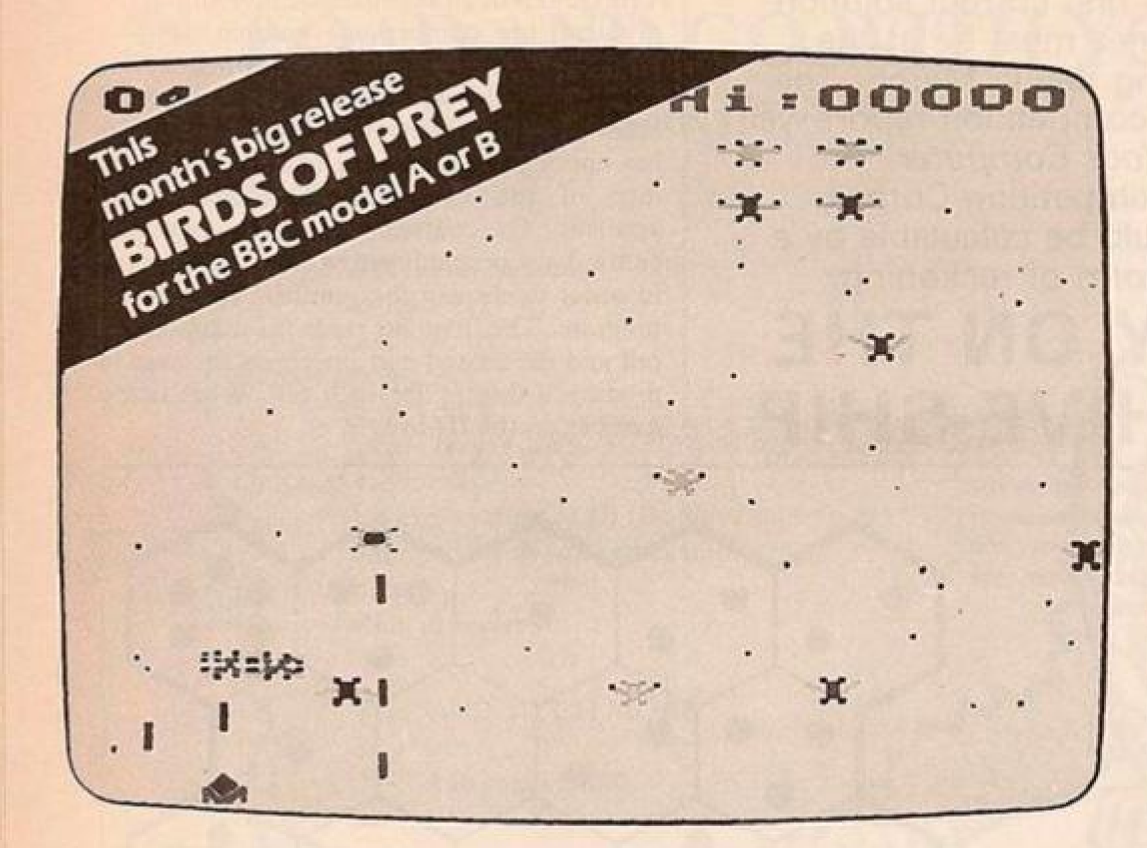
Racked with indecision we finally chose the entry from T Hardman 16 Arabin Road, London SE20, as the winner. He noticed the palindrome and suggested the stripped-down "Texet — it's a winner whichever way you look at it".

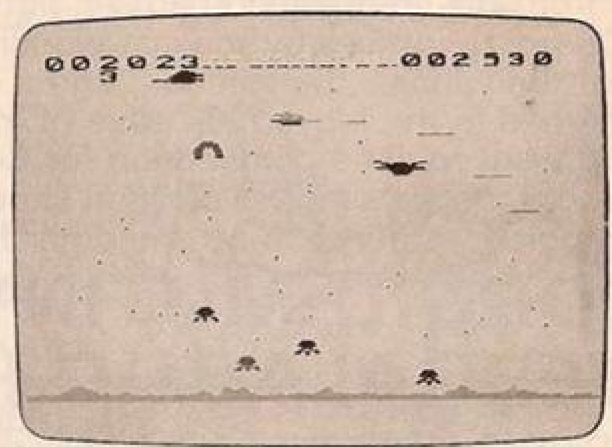
A surprising number of entries for the Pyramid of Agpar problem gave the wrong answer. Some people had not realised that there must be a central globe inside the pyramid.

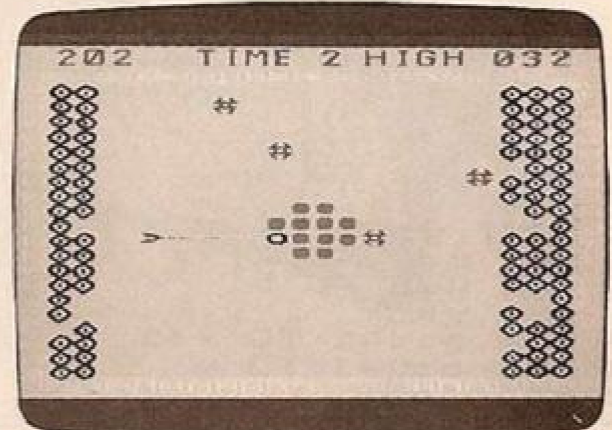
The £15 book token goes to M Swain, 8 Woodland Road, Newport, Gwent, NPT 8LS, whose correct solution was the first out of the competition bag.

His reasoning was as follows: in 24 hours it is possible to break into 19 spheres. From each sphere you can take as many stones as there are connecting tubes. The central sphere has 12 tubes; each side sphere has nine tubes and edge spheres have six tubes.

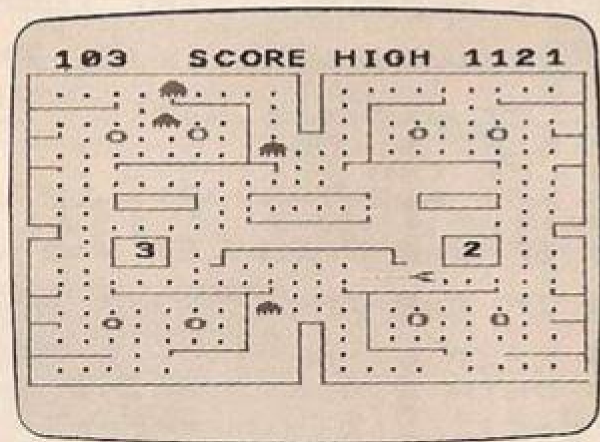
Since you can break into 12 side spheres, six edge spheres and the one centre sphere, the total number of stones that can be removed is 156. ■



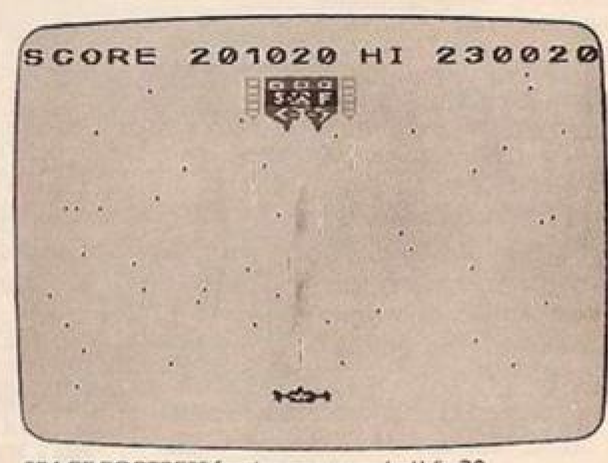

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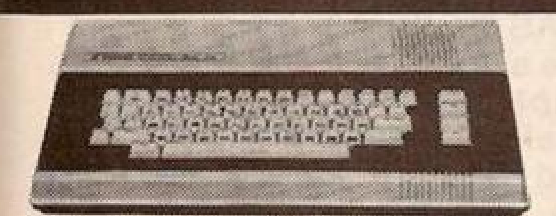
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Cassette Lead	Included

COLOUR GENIE



A truly reliable micro and highly recommended by **SPECTRUM** featuring powerful and sophisticated COLOUR GRAPHICS, allowing you to create full 8-colour Games, Diagrams and charts quickly and simply. Powerful 16KK RAM memory (expandable internally to 32K) for FULL COLOUR video games and POWERFUL COMPUTING with a full range of inexpensive accessories: 16K RAM pack, Joysticks for TV games, Light Pen, Disk Drive and a Printer. The superb Colour Genie is at SPECTRUM now - check it out and see the Genius at work!

Spectrum Price £224.48 Inc. VAT

COLOUR GENIE ACCESSORIES

Joysticks	£49.49
16K RAM	£38.50
Printer Interface	£39.95
VISCOUNT Teach yourself Colour Genie Basic	£6.95

SPECTRUM FACTS

Maximum user RAM	**14,200 Bytes (approx)**
Text screen	**24x40**
High Resolution	**160x90**
Cassette Lead	**Included**

SINCLAIR ZX SPECTRUM



Yes, this top selling micro is now available from Spectrum in both **16K** and **48K RAM**. So now there's no need to send by Mail Order - just call into your local SPECTRUM dealer and pick one up. But just one word of warning: with this added avilability advantage, stocks are bound to sell fast - so make it soon!

SINCLAIR ZX SPECTRUM 16K - £99.95
SINCLAIR ZX SPECTRUM 48K - £129.95

Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

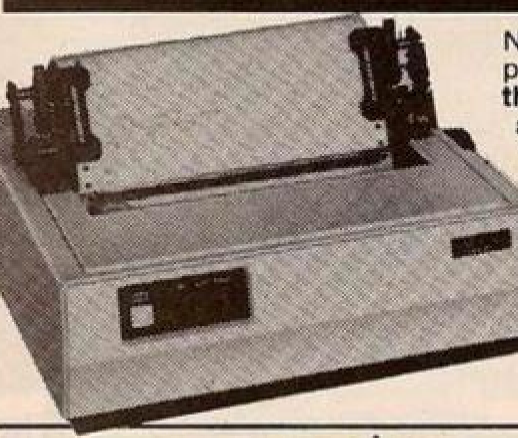
SINCLAIR ZX-81

SINCLAIR ZX . . . £49.95
16K RAM pack . . £29.95
ZX Printer £39.95

Computer Bookshop Software for Sinclair Computers	INC. VAT
Bumper 7 1K ZX81	£5.95
1K Super Trio ZX81	£7.95
Labyrinth 16K ZX81	£5.95
Nightmare Park/Music 16K ZX81	£6.95
Computacalc 16K ZX81	£7.95
Personal Banking System 16K ZX81	£11.44
Space Invaders/Rescue 16K ZX81	£6.95
Breakout 16K ZX81	£5.95
Mugsy 16K ZX81	£5.95
Mergatroyds 16K ZX81	£5.95
Progmerge 16K ZX81	£5.95
Football Manager 16K ZX81	£7.95
Cassettes for ZX81 Type—10	
6 Games	£3.95
Junior Education	£3.95
Business & Household	£3.95
Skill & Judgement Games	£3.95
Junior Education	£3.95
Family Quiz	£3.95
Type—20	
Fantasy Games	£4.75
Space Raiders & Bombers	£4.75
Type—30	
Super Programs Nos. 1-8	£4.95
Type—40	
Backgammon	£5.95
Flight Simulation	£5.95
Type—50	
English Literature 1	£6.95
English Literature 2	£6.95
Geography	£6.95
History 1	£6.95
Maths. 1	£6.95

ZX-PANDA
16K RAM PACK
ONLY £24.95

OKI MICROLINE Printers



Now from **SPECTRUM** - this **top selling** range of printers **renowned throughout the world for their quality and reliability.** If you're thinking of adding a printer to your micro then you must take a look at the **MICROLINE** range at **SPECTRUM -NOW!** they're **fantastic value-for-money**

Models available

MICROLINE Model 80 £259.90
MICROLINE Model 82A £455.40
MICROLINE Model 92P £585.35

EPSON



The new **EPSON**

RX-80 and **FX** printers now available—check with your local **SPECTRUM** dealer **NOW!**

FX-80 Spectrum Price **£503.70**
RX-80 Spectrum Price **£332.35**

SEIKOSHA



GP-100A

Now a top quality graphic printer at a price you can afford. Centronics interface connects easily with most micros.
Spectrum price **£229.94** Inc VAT Cables & Interfaces available for most micros

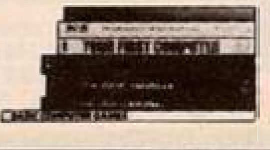
SMITH CORONA



Model TP-1

Microprocessor controlled, high quality daisy wheel printer at a LOW cost from SPECTRUM. Serial, Parallel or IEEE Interface.
Spectrum LOW price **£557.75** Inc. VAT

BOOKS



SELECTION FROM THE COMPUTER BOOKSHOP

30 Hour Basic for the BBC Micro	£5.95
Let your BBC Micro Teach You to programme	£6.45
BBC Micro Revealed	£7.95
Over the Spectrum	£6.95
60 Games and Applications for the ZX Spectrum	£4.95
Programming the 6502	£9.95
Programming your ZX Spectrum	£6.95
ZAP Pow Boom for the Vic 20	£7.95
The ZX Spectrum Explored	£5.95
Vic Inovative Computing	£6.95
Mastering Machine Code on your Zx81	£7.50
The ZX Spectrum and how to get the most from it	£5.95
Easy Programming for the ZX Spectrum	£5.95
30 Programmes for the BBC Micro	£4.95
CPM Handbook	£11.50
Programming the Z80	£11.95
20 Best Programmes for the ZX Spectrum	£5.95
Getting aquainted with your Vic 20	£6.95
Machine code and Better Basic	£7.50
The Cambridge Colour Collection (Spectrum)	£6.95
Vic Revealed	£10.00
De RE Atari	£17.00
ATARI Operating system listing	£10.43

MORE SPECTRUM LOW PRICES ☞

Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

spectrum

A truly amazing offer on this expandable & Comprehensive top-of-the-line Micro.

Yes, now from **SPECTRUM** the **fabulous TEXAS TI-99/4A** Home Micro at a **super NEW LOW PRICE - Plus!** a super **FREE!** offer too! When you return your **FREE OFFER VOUCHER** obtainable at time of purchase to **TEXAS INSTRUMENTS** they will send you **absolutely FREE!** a **PAIR OF JOYSTICKS - worth £24.95. A beginners BASIC TUTOR PROGRAM -Worth £9.95** and a **CONNECT 4 PROGRAM - Worth £15.95. TOTAL VALUE £50.85** (which means you're effectively **only paying £99.10** for your **TEXAS TI-99/4A micro.) A fantastic offer - HURRY** to your local **SPECTRUM** dealer **NOW** and see for yourself just what **great value this really is.** Offer closes June 30th.

Plus!

FREE!

Goods worth £50.85

FREE! Pair of Joysticks worth £24.95

FREE! Beginners BASIC Tutor program worth £9.95

FREE! Connect Four program worth £15.95

With every TEXAS TI-99/4A purchased. See opposite for details.

Super NEW LOW PRICES on

TEXAS SOFTWARE

from Spectrum too!



The Spectrum top 30

- Connect Four...... £15.95
- Zero Zap.......... £15.95
- Attack............ £15.95
- Blasto............ £15.95
- Hustile........... £15.95
- Yahtzee........... £15.95
- Hangman........... £15.95
- T.I. Invaders..... £19.95
- A-maz-ing......... £19.95
- Wumpus............ £19.95
- Carwars........... £19.95
- Oldies but Goodies £12.95
- Soccer............ £24.95
- Tomb Stone City... £24.95
- Munchman.......... £29.95
- Chess............. £39.95
- Parsec............ £29.95
- Alpiner........... £29.95

EDUCATIONAL GAMES

- Dragon Mix........ £27.95
- Aligator.......... £27.95

ADVENTURE PROGRAMS

- Adventure & Pirate . £29.95
- Adventure Land.... £19.95
- Mission Impossible £19.95
- Voodoo Castle..... £19.95
- The Count......... £19.95
- Strange Odyssey . £19.95
- Mystery Funhole... £19.95
- Pyramid of Doom . £19.95
- Ghost Town........ £19.95
- Golden Voyage £19.95

PLUS!

FREE!

SPEECH SYNTHESISER
or
TI CASSETTE RECORDER
each worth £49.95

When you buy any 6 Texas Software modules.

An additional **BONUS OFFER** from **SPECTRUM!** Purchase 6 (or more) **TEXAS software modules** - send your receipt to **TEXAS INSTRUMENTS** and you'll receive a **FREE SPEECH SYNTHESISER** or a **TEXAS TI CASSETTE RECORDER** each **worth £49.95** -ask your local **SPECTRUM** for details NOW!

TEXAS TI-99/4A - just part of a complete system.

The **TEXAS T1-99/4A** is just part of a **complete system** which can be **expanded simply & easily** with **optional peripherals (disk drives, printers etc.)** and **easy-to-use Solid State Software modules.** A system which **will meet your needs today & tomorrow** - a system you can **grow with** as and when the needs arise. It can use up to **4 different programming languages** and more than **600 software programs** are available worldwide. Last but not least-it comes from the people with the **greatest experience in microprocessors-the inventors themselves:** so if you're considering buying a home micro you **must** take a look at the **TEXAS TI-99/4A** at your local **SPECTRUM dealer NOW - it really is a terrific buy!**

Unbelievable but true!

TEXAS

TI-99/4A Micro Offer!



Specifications for TEXAS TI-99/4A.

Console CPU: 9900 Family, 16-bit microprocessor, plus 256-byte scratchpad RAM.
Memory: Total combined memory capacity: 110 KBytes. Internal ROM memory supplied: 26 KBytes. External ROM memory: (Solid State Software® command modules) up to 36 KBytes each.
RAM memory supplied: 16 KBytes (Expandable to 48 KB).
Keyboard: 48 key QWERTY with control and function keys (user definable), full upper and lower case capability, alpha lock, auto repeat.
Sound: 5 octaves, 3 simultaneous tones plus noise generator. Each tone controlable in 1Hz steps from 110 Hz to beyond the audible range.
Colours: 16 foreground and background colours.
Video resolution: 192 x 256 (24 x 32 characters).
Power: 240V - 50Hz - 25W in seperate power supply unit.
I/O: UHF modulated PAL colour signal for UK TV receivers.
I/O: UHF modulated PAL-Colour signal for connection to your own T.V. Interface for up to 2 domestic audio cassette recorders. 44-pin peripheral connector-up to 3 peripherals attached simultaneously. System memory and address signals available at peripheral connector. Interface for 2 Wired Remote Controllers.
Built in Software: 14 KByte BASIC interpreter. Internal Graphics Language interpreter, not user accessible. Internal 4.4 KByte monitor (not user accessible).

SPECTRUM SENSATIONAL PRICE - NOW ONLY

£149.95

INC. VAT

MORE SPECTRUM LOW PRICES ☞

Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

spectrum

A few examples from our

SOFTWARE Selection

from independent software houses

THORN EMI

Software for ATARI	Inc. VAT
Submarine Commander	£34.44
Jumbo Jet Pilot	£34.44
Soccer	£29.84
Kickback	£29.84
Home Financial Management	£19.49
Darts	£19.49
Snooker & Billiards	£19.49
Pool	£19.49
Cribbage & Dominoes	£19.49
Cupute 4 & Reversi	£14.89
Mutant Herd	£24.25
Software for Commodore	
River Rescue	£25.24
Vic Music Composer	£25.24

GEM

Software for ZX81, Dragon and Spectrum	Inc. VAT
Monster Mine (for ZX81)	£4.95
Monster Mine (for Spectrum)	4.95
Monster Mine (for Dragon)	7.95
Space Mission (for ZX81)	£4.95
Space Mission (for Spectrum)	£4.95
Space Mission (for Dragon)	£7.95
Dragon Golf	£7.95
Dragon Character Generator	£9.95

SALAMANDER

Games for Dragon 32	Inc. VAT
Dragon Trek	£9.95
Wizard War	£7.95
Vulcan 0	£7.95
Games Compendium DI	£7.95
Golf	£7.95

RABBIT

Software for Commodore VIC20	Inc. VAT
Space Storm	£6.99
Ski Run	£4.99
Dune Buggy	£4.99
Super Worm	£4.99
Jungle	£4.99
Cosmic Battle	£4.99
Frogger(3K)	£4.99
Rabbit Functions	£4.99
Code Breaker	£4.99
Night Fight (3K)	£4.99
Rabbit Writer (16K Cassette)	£19.99
Rabbit Base (16K Cassette)	£14.99
Myriad (3K)	£9.99
Charset/20 (3K)	£4.99
Skramble	£9.99
Space Phreeks	£9.99
Night Crawler	£9.49
Hopper	£9.99
Tank War	£7.99

KUMA

Software for Sharp	
Electron 22622	£9.20
Cribbage	£12.08
Adventure	£12.08
Chess	£16.68

AUDIOGENIC

Programs for VIC-20	Inc.VAT
Amok	£6.95
Alien Blitz	£7.95
Golf	£7.95
Spiders of Mars	£19.95
Sattelite & Meteorites	£19.95
Bonzo	£7.95
Trashman	£19.95
Boss	£14.95
Tank Attack	£19.95
Word Craft Word Processing package	£125.00

Plus many more at your local SPECTRUM dealer -call in now and see!

ACCESSORIES



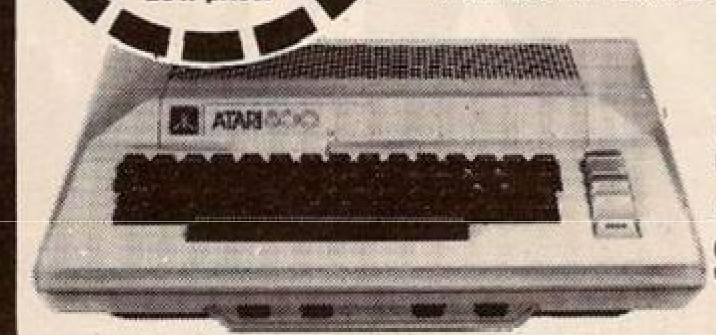
SANYO Colour Monitor
CDD3125H
£228.85

SANYO	Inc. VAT
SANYO 12" green monitor	£90.85
Slim 3G Cassette Recorder	£29.95
C12 Cassettes	£0.50
Single sided double density disks (Box of 10)	£21.25
Double sided, double density disks (Box of 10)	£33.81
Disk head cleaner	£16.10
Single part 11" x9½" printer paper, box of 2,000 sheets	£13.05
VIC Accessories from Viscount	
Motherboard without Buffer	£24.95
Motherboard with Buffer	£29.90
16K RAM Pack	£43.95
32K RAM Pack	£66.95
64K RAM Pack	£114.94
Currah ChatterboxVoice Synthesiser	£57.45

Now with 48K RAM and still at the same LOW price!

ATARI 800

Now this proven and tested machine has been upgraded to a massive **48K RAM** and its still at the amazing **LOW** price of**£399.99** from **SPECTRUM.** It's an idea Home Micro for graphics, educational and personal finance etc. use it and it wi take you from learning up to a small business use. You can add printers, program recorders, disk drives and more, to expand your micro as and when you want, to suit your needs. So if you're looking for a top of the line micro you must see the **ATARI 800 with 48K at SPECTRUM - NOW!**



Spectrum Price

£399.99 INC. V.A.T.

SPECTRUM FACTS

Maximum user RAM	37,899 Bytes
Text Screen	24 × 40
High Resolution	320 × 192
Cassette Lead	Needs own Recorder

ATARI 400

16K RAM



NOW ONLY £159.95 INC. VAT

BASIC cartridge extra
£39.99 inc. VAT
(£34.77 ex. VAT)

SPECTRUM FACTS

Maximum user RAM (with basic Cartridge)	13,323 Bytes
Text Screen	24 × 40
High Resolution	320 × 192
Cassette Lead	Needs own Recorder

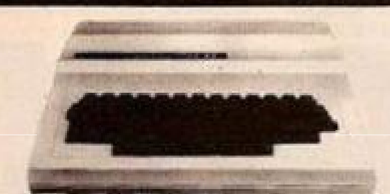
ATARI DISK DRIVE
£299.00 INC. VAT

ACCESSORIES, BOOKS & GAMES for ATARI

Accessories	INC VAT
Thermal Printer	£198.95
16K RAM Pack	£65.00
400 Keyboard	£59.95
32K RAM board (400/800)	£75.00
48K RAM board (400/800)	£99.00
Paddles (Pair)	£13.99
Joysticks (Pair)	£13.99
I/O Cable	£12.99
Printer Cable	£28.50
Monitor Cable	£25.00
Thermal Paper	£4.00
Pointmaster Joysticks	£14.95
Quickshot Joysticks	£14.95
Keyboard for Atari 400	£00.00
Books & Manuals	
Wiley Manual	No VAT
Basic Reference Manual	No VAT
DOS. 2 Manual	No VAT
Operating System Listing	No VAT
DOS. Utilities Listing	No VAT
Home Computer Programs – Home/Office	
Word Processor (Disk)	£99.99
Mortgage & Loan	£14.99
Microsoft Basic (Diskette)	£59.99
Home Study (Cassette except where stated)	
INV. to programming 1	£19.99
INV. to programming 2	£22.99
INV. to programming 3	£22.99
Conversational French	£39.99
Conversational German	£39.99
Conversational Italian	£39.99
Conversational Spanish	£39.99

	INC VAT
European Countries & Caps	£14.99
Hangman	£14.99
Kingdom	£14.99
States & Capitals	£14.99
Touch Typing	£19.99
Music Composer (Cartridge)	£35.99
Home Entertainment (Cartridge except where stated)	
Galaxian	£29.99
Defender	£29.99
Asteroids	£29.99
Basketball	£24.99
Blackjack (Cassette)	£14.99
Caverns of Mars (Disk)	£29.99
Centipede	£29.99
Computer Chess	£24.99
Missile Command	£29.99
PAC Man	£29.99
Space Invaders	£29.99
Star Raiders	£29.99
Cribbage & Domino	£19.95
European Scenic Jig-saw	£19.99
Programming Languages & Aids	
Assembler Editor	£39.99
Atari Basic Cartridge	£39.99
Macro Assembler (Disk)	£59.99
Pilot (Consumer)	£59.99
Pilot (Educator)	£89.99
Entertainer Kit (Star Raiders Missile Command & Pair Joysticks)	£69.99
Programmer Kit (Basic Cartridge & Manuals)	£39.99

DRAGON



Spectrum Price £199.95

VISCOUNT Teach yourself Dragon Basic . £6.95

Unbelievable value from SPECTRUM! Extensive facilities include highly advanced colour graphics. Powerful standard 32K RAM (expandable to 64K Bytes). ● 9 Colour 5 resolution Display ● Extended Microsoft colour BASIC (as standard) ● Advanced sound with 5 octaves - 255 tones

SPECTRUM FACTS

Maximum user RAM	29,679 Bytes
Text Screen	16x32
High Resolution	256x192
Cassette Lead	Included

JUPITER ACE



SPECTRUM FACTS

Maximum user RAM 1,000 Bytes approx.

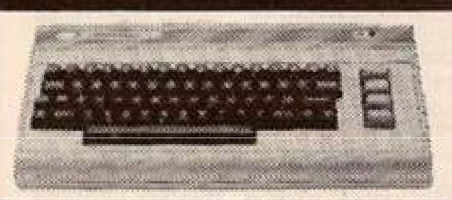
Outstanding value-for-money! The **JUPITER ACE** uses easy to understand FORTH language. **3K RAM EXPANDABLE to 19K. Full moving keyboard** with auto repeat and caps lock. **Full sound and chunky graphics.**

Spectrum Price £89.95

HI-TECH Software for JUPITER

Memory Stars	£5.99
Cavern Attack	£5.99
Micro Maze	£6.50
Space Battle	£4.50
Ace Invaders	£5.50
Green Cross Frog	£4.80

COMMODORE 64



Powerful 64K RAM

40-colour displays to monitor TV. High resolution graphics and 3-dimensional effect capability, music synthesiser. Z80 additional processor option.

Spectrum Price

£345.00
INC. VAT

VIC 20
Spectrum Price £129.90

SPECTRUM Special!
AMAZON
Business Software for
ATARI 800
at less than
HALF PRICE!
Key Account
ONLY £69.00

Key Word
ONLY £69.00

 Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

There's a Spectrum Centre near you . . .

ABERYSTWYTH
AberData at Galloways, 23 Pier St. 0970 615522

ABINGDON
Ivor Fields Computers, 21 Stert St. 0235 21207

ACCRINGTON
PV Computers, 38A Water St. 0254 36521/32611

ALDERSHOT
David Saunders Computer Centre, 51 Station Rd. 0252 20130

ALFRETON
Gordon Harwood, 69/71 High St. 0773 832078

BANBURY
Computer Plus, 2 Church Lane. (0295) 55890

BARROW-IN-FURNESS
Barrow Computer Centre, 96 Church St. 0229 38353

BASILDON
Godfrey's, 28-32 East Walk, Town Centre. 0268 289379

BASINGSTOKE
Fisher's, 2/3 Market Place. 0256 22079

BATH
Software Plus, 12 York St. 0225 61676

BEDFORD
Stanad Ltd., 115 Midland Rd. 0234 49341

BELFAST
Arthur Hobson Ltd., 37 Great Victoria St. 0232 246336

BIRMINGHAM
Sherwoods, Great Western Arcade. 021 236 7211

BOSTON
Fotosound Computers, 19 Dolphin Lane. 0205 64781

BRADFORD
Photosave, 18 Cheapside. 0274 308598

BRIGHTON
Capricorn, 1 Queens Rd. 0273 29634

BRISTOL
Brensal Computers Ltd., 24 Park Row. 0272 294187

BURNLEY
IMO Computer Centre, 39-43 Standish St., 0282 54299

BURY (Lancs.)
Micro-North, 7 Broad St. Tel. 061-797 9764

BURY ST. EDMUNDS
Bury Computer Centre, Tel. 061-797 9764

CANTERBURY
Camera Arts (Micro Computer Division), 36 High St. (0276) 65848

CAMBRIDGE
KP Ltd., 12a Kings Parade. 0223 68087

CAMBERLEY
Kent Micro Systems, Conquest House, 17 Palace St. 0227 50200

CARDIFF
Randall Cox, 18-22 High St. Arcade. 0222 31960

CHELMSFORD
Maxton Hayman Ltd., 5 Broomfield Rd. (0245) 354595

CHESHAM
Reed Photography & Computers, 113 High St. 0494 783373

COVENTRY
Coventry Micro Centre, 33 Far Gosford St. (0203) 58942

CREWE
Microman, 123 Nantwich Rd. Tel. TBA

CROYDON
Cadcom Ltd, 96 Whitgift Centre (Next door to MacDonald's) 01-686 8393

DARLINGTON
McKenna & Brown, 102 Bondgate. (0325) 59744

DERBY
C T Electronics, at Camera Thorpe, The Spot. 0332 44760

DUMFRIES
Vennals, 71 English St. 0387 4547

DUNSTABLE
Dormans, 7-11 Broad Walk. 0582 65515

EDGWARE
Breaker 1-4, 130 High Street. 01-952 7488/8860

EDINBURGH
Edinburgh Computers-at Edinburgh Cameras, 51-57 Lothian Rd., 031 229 4416

EDINBURGH
The Silicon Centre, 6-7 Antigua St. 031 557 4546

EVESHAM
Tecnicare, The Lodge, Brickiln St.. 0386 41484

EXMOUTH
Open Channel, 30 The Strand. 03952 4408

GLASGOW
Victor Morris Ltd., 340 Argyle St. 041 221 8958

GLOUCESTER
The Model Shop, 79-81 Northgate St. (0452) 410693

GRIMSBY
R. C. Johnson Ltd., 22 Friargate, Riverhead Centre. 0472 42031

GUERNSEY
Grut's, 3-5 The Pollet, St Peters Port. 0481 24682

GUILDFORD
The Model Shop, 23 Swan Lane. (00772) 0483 39115

HAMILTON
Tom Dickson Computers, 8-12 Cadzow St. 0698 283193

HARROW
Camera Arts (Micro Computer Division), 24 St. Ann's Rd. 01-427 5469

HATFIELD
Microworld, 2 Crawford Rd. (07072) 64137

HEMEL HEMSTEAD
Faxminster Ltd, Computer & Electrical Discount Centre, 25 Market Square. 0442 55044

HEREFORD
Melgray Hi-Tech Ltd, 49 Broad St. 0432 275737 (Just Opening)

HESWALL
Thornguard Computer Systems 46 Pensby Rd. 051-342 7516 (Opening Soon)

HITCHIN
Camera Arts (Micro Computer Division), 68A Hermitage Rd. 0462 59285

HULL
The Computer Centre (Humberside) Ltd., 26 Anlaby Road (0482) 26297

ILFORD
Prot Enterprises, 1 Centreway, (next to Sainsburys) High Rd. 01-553 0144

IPSWICH
Brainwave, 24 Crown St. 0473 50965

ISLE OF MAN
T. H. Colebourn Ltd., 57-61 Victoria St., Douglas. 0624 3482 (Just Opening)

JERSEY
Audio & Computer Centre 7 Peter St., St. Helier. 0534 74000

KILMARNOCK
Vennals, 49 Foregate 0568 32175

KIRCALDY
R. Kilpatrick, 254E High St. Tel. T.b.a. (Opening soon)

LEAMINGTON SPA
IC Computers, 43 Russell St. 0926 36244 (Opening Soon)

LEEDS
Bass & Bligh, 4 Lower Briggate. 0532 454451

LEICESTER
Youngs, 40-42 Belvoir St. 0533 544774

LEIGHTON BUZZARD
The Computer Centre at Milton Keynes Music, 17 Bridge St. 0525 382504/376622

LITTLEHAMPTON
Alan Chase Ltd., 39 High St. 09064 5674/4545

LIVERPOOL
Beaver Radio, 20-22 Whitechapple. 051-709 9898 (Opening Soon)

LIVERPOOL (Aintr
Hargreaves, 31/37 Warbreck Moor. 051-525 1782

LONDON E8
McGowans, 244 Graham Rd. Hackney. 01-533 0935

LONDON EC2
Devron Computer Centre, 155 Moorgate. 01-638 3339/1830

LONDON SE1
Vic Odden's, 6 London Bdg. Walk 01-403 1988

LONDON SE9
Square Deal, 375 Footscray Rd., New Eltham. 01-859 1516

LONDON SE15
Castlehurst Ltd., 152 Rye Lane, Peckham. 01-639 2205

LONDON SE9
Chelsea Micros Ltd., 14 Jerden Place. 01-385 8494

LONDON N1
ASP Micro Systems, 185 Upper St., Islington. 01-359 9095

LONDON N14
Youngs Electronic t/a Fieldmaster, 19 The Broadway, The Bourne, Southgate 01-882 5579

LONDON N.20
Castlehurst Ltd., 1291 High Rd. 01-446 2280

LONDON NW9
Moviescope, 459 Kingsbury Rd., London NW9. 01-204 6352

LONDON W1
Devron, 4 Edgware Road. 01-724 2373

LONDON W1
Computers of Wigmore Street, 87 Wigmore St. 01-486 0373

LONDON W3
Colormatic Computers, 44 High St., Acton. 01-992 7611

LONDON W11
Electroleisure, 120 Notting Hill Gate. 01-221 7029

LOUGHTON
Micro & Movie Channel 309 High Rd. 01-508 1216

LOWESTOFT
John Wells, 44 London Rd. North. 0502 3742

LUTON
Terry-More, 49 George St., 0582 23391/2

MACCLESFIELD
Camera & Computer Centre, 118 Mill St. 0625 27468

MANCHESTER
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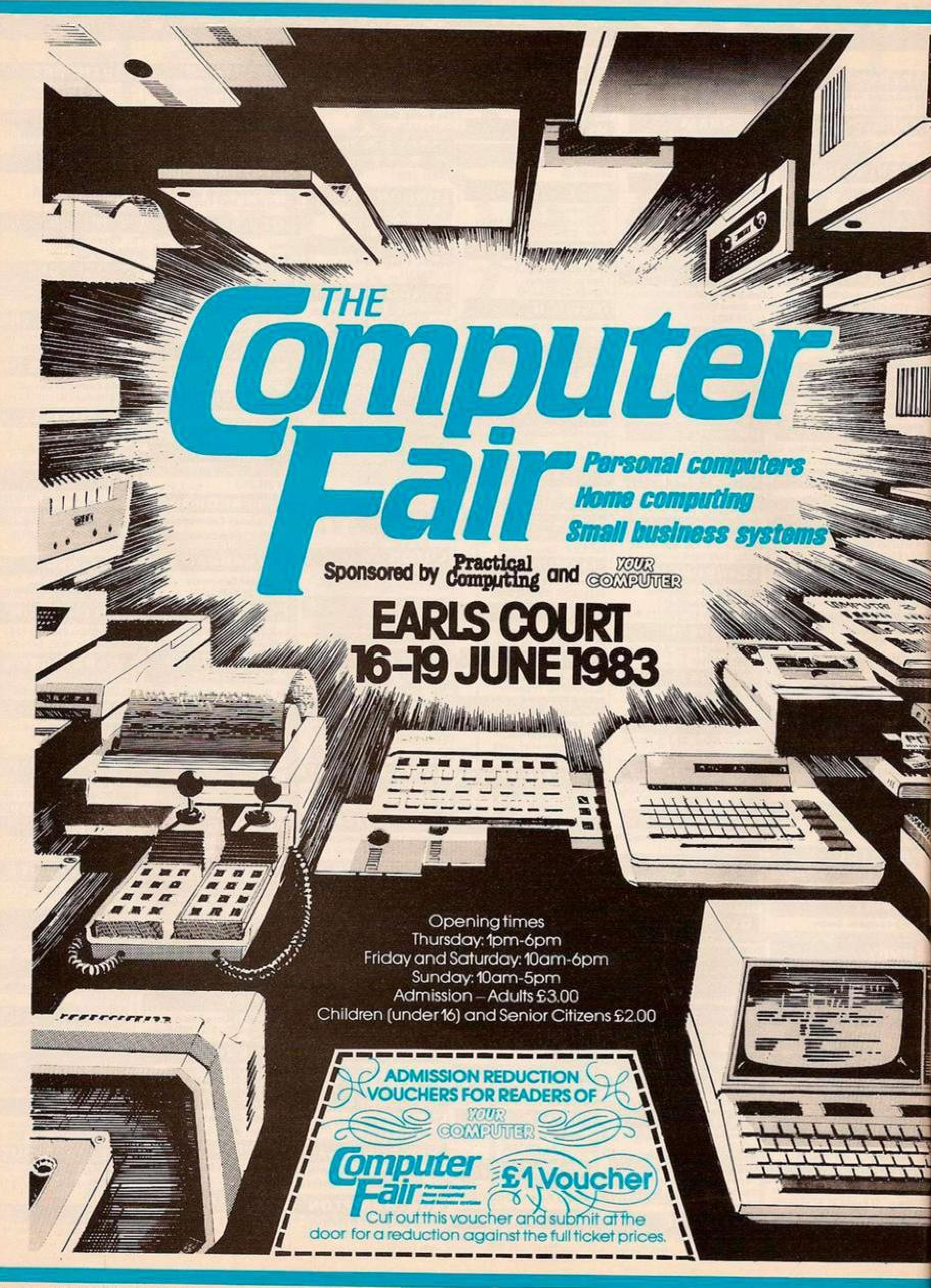
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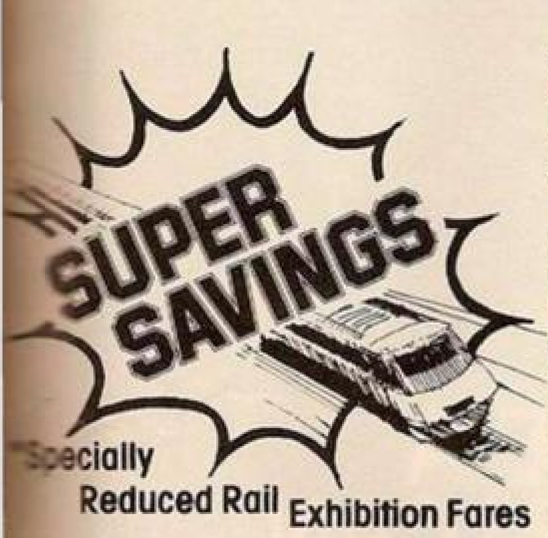
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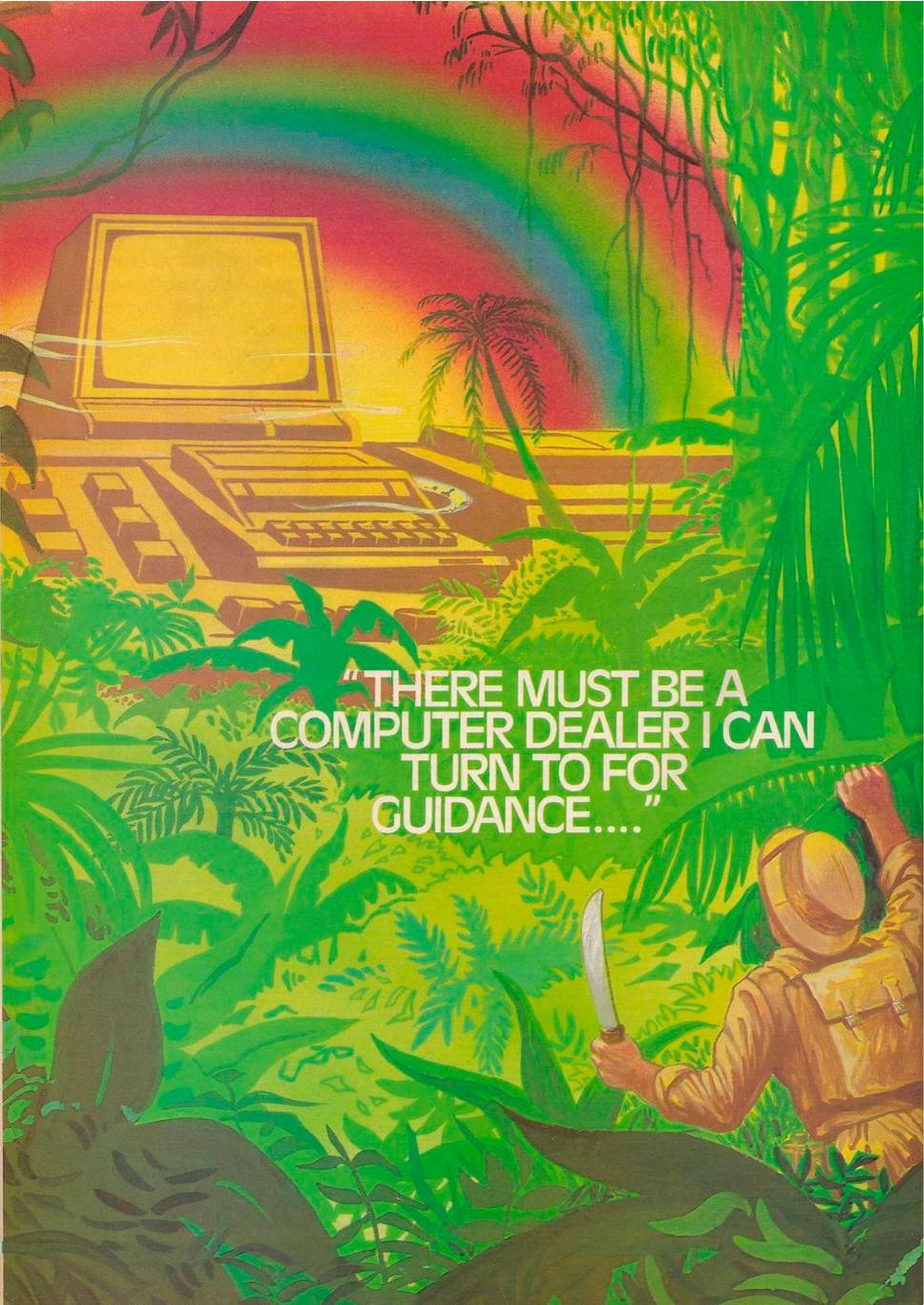
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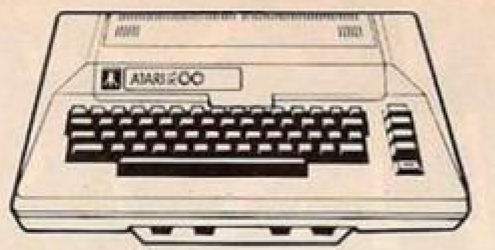
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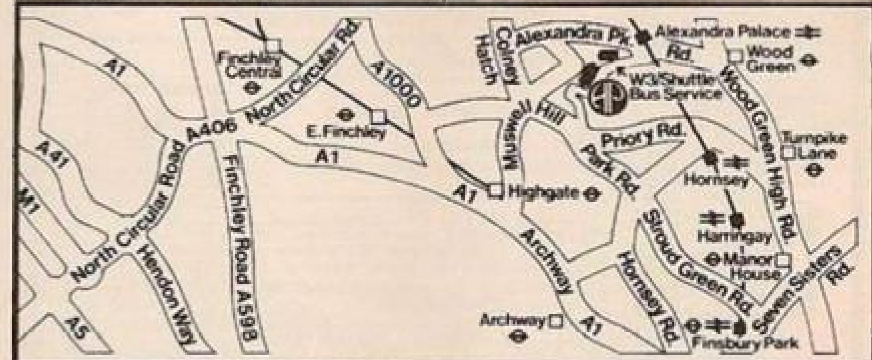
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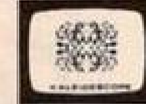
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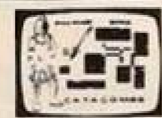
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Although the NewBrain is conceived as a total system, the unexpanded Processor itself has a great deal to offer. It is available in two forms: Model AD, shown below, with a built-in line display; and Model A, without the line display. Both models can operate with a monitor or a television set.

MEMORY

□ 24K bytes of ROM;
□ 32 bytes of RAM, at least 28K of which is available to the user.

THE SCREEN DISPLAY

□ 40 or 80 characters to the line – without affecting the 28K bytes of RAM at your disposal;
□ 24 or 30 lines to the screen;
□ well-formed characters, with true descenders;
□ a full European character set;
□ normal or reverse video, high resolution graphics on screen of controllable size, 256, 320, 512 or 640 horizontal resolution by 250 vertical lines;
□ a facility to set up a "page" of up to 255 lines, with the screen acting as a "window" to display it;
□ ability to maintain several such pages simultaneously, and to switch rapidly between them;
□ text may be used on graphics screen as well as on parts of the video screen not used by graphics.

CHARACTER SET

□ 512 characters, including the full ASCII set, all European accented characters, Greek and graphics symbols.

GRAPHICS

□ 20 powerful graphics commands;
□ all text characters usable on the graphics screen;
□ variable-sized graphics screen, with the rest of the screen available for text – for versatility and to save memory.

SOFTWARE

Enhanced ANSI BASIC; screen editor (32 commands); mathematics package (10 significant figures); graphics commands.

□ a very friendly screen editor – a delight to use and readily adapted to text processing;
□ arithmetic to 10 significant figures;
□ very controllable output formatting of numbers – invaluable for accounting, statistics, and scientific applications;
□ a powerful, much enhanced BASIC;
□ a very flexible operating system, which allows any data stream to be opened to any device.

INTERFACES

□ two tape cassette ports built into the processor unit;
□ a built-in printer interface;
□ a built-in communications interface (V24/RS232);
□ a video monitor interface;
□ a TV interface;
□ an expansion interface for NewBrain system expansion modules.

KEYBOARD

□ standard typewriter pitch, action, layout and size, with editing control and graphics keys.



*CP/M IS A REGISTERED TRADE MARK OF DIGITAL RESEARCH INC.

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If you understand the facts and figures on the left you'll soon realise that NewBrain has to be one of the most powerful micros around.

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We've got over 120 dealers nationwide who've got all the answers at their fingertips.

Either way you'll discover that NewBrain is the kind of micro that will stop the competition getting a look in.

At £269 it starts off with twice as much memory as most of its competitors and can expand to over thirty times that amount. So there's no chance of being left behind in the micro race.

It comes with a very powerful language (enhanced ANSI-BASIC) and it'll take CP/M,* so it'll work on the same system as similar big business micros, giving you the capacity to use an almost limitless variety of tried and tested software.

But most of all NewBrain is a machine that can expand.

It's designed to take disks, printers and memory expansion modules (up to 2M bytes) plus anything else you'd expect a professional business micro to handle.

So, whether you understand the box on the left or not, pay a visit to someone in the know on the right.

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Critical review?

"The sound commands on the Oric 1 are, for a computer of this price, very sophisticated. Three music channels, and one noise channel, mean that you can program some fairly complex sounds."

POPULAR COMPUTING WEEKLY

"Oric is everything you hoped it would be. Alive with colour, and zapping with built-in sound effects, the Oric looks like a match for any machine now selling for less than £200"

YOUR COMPUTER

"The 16k Oric – fighting the 16k Spectrum – is £25 cheaper. It feels a good deal more 'professional' than the home-appeal Sinclair. Oric's sound is extremely versatile, and well up to the standard of the £300 or £400 BBC microcomputer made by Acorn."

WHICH MICRO?

"Oric was over twice as fast as the Spectrum. Surprisingly perhaps the Oric, which initially seemed only faster when performing the simplest of calculations, has come back to beat the Spectrum by a small amount. As the problems get more complex the Oric comes into its own. One final point – in entering the benchmark tests – the Oric was certainly the easiest to handle."

WHICH MICRO?

"This slope coupled with the design of the keys makes the Oric an easy machine to touch-type on. All keys have auto-repeat and there are four keys dedicated specifically to cursor control. It is certainly easier to type on than any of Sinclair's offerings."

YOUR COMPUTER

"Oric will soon be selling a Modem so that Prestel will become available. Owners will be able to accept telesoftware – programs loaded straight down the phone line – eventually electronic mail could come into the home by the same route, and with the addition of a tape recorder the Oric with its Modem could become a telephone answerer and message taker."

YOUR COMPUTER

"One good feature of the Oric is an on-screen reminder in the top right hand corner to show that you've engaged all-capitals mode. So much better than the BB's variety of lights in the corner of the keyboard. The Oric is sound, simple to get along with and offers great expansion potential."

WHICH MICRO?

"When compared to the stogginess of the Spectrum's keyboard this is certainly an improvement. I can't see any Orics failing through bad assembly. If only the £2400 IBM were so easy to use."

WHICH MICRO?

"Instead of the Spectrum's 28 look-up single-character error reports, the Oric has 18 self-explanatory messages. If you actually want to do computing, rather than just exploring the world of off-the-shelf games programme entertainment the Oric will be a better buy."

WHICH MICRO?

"A good speaker and built-in noises get the Oric's sound off to a good start. Typing Zap, Ping, Shoot or Explode produces convincing arcade game noises which can easily be incorporated into any program."

YOUR COMPUTER

"The modem is certainly unusual in a machine of this price. Together with the other peripherals, when finally available, it should make for an attractive package for a small business...surely a match for machines costing much more"

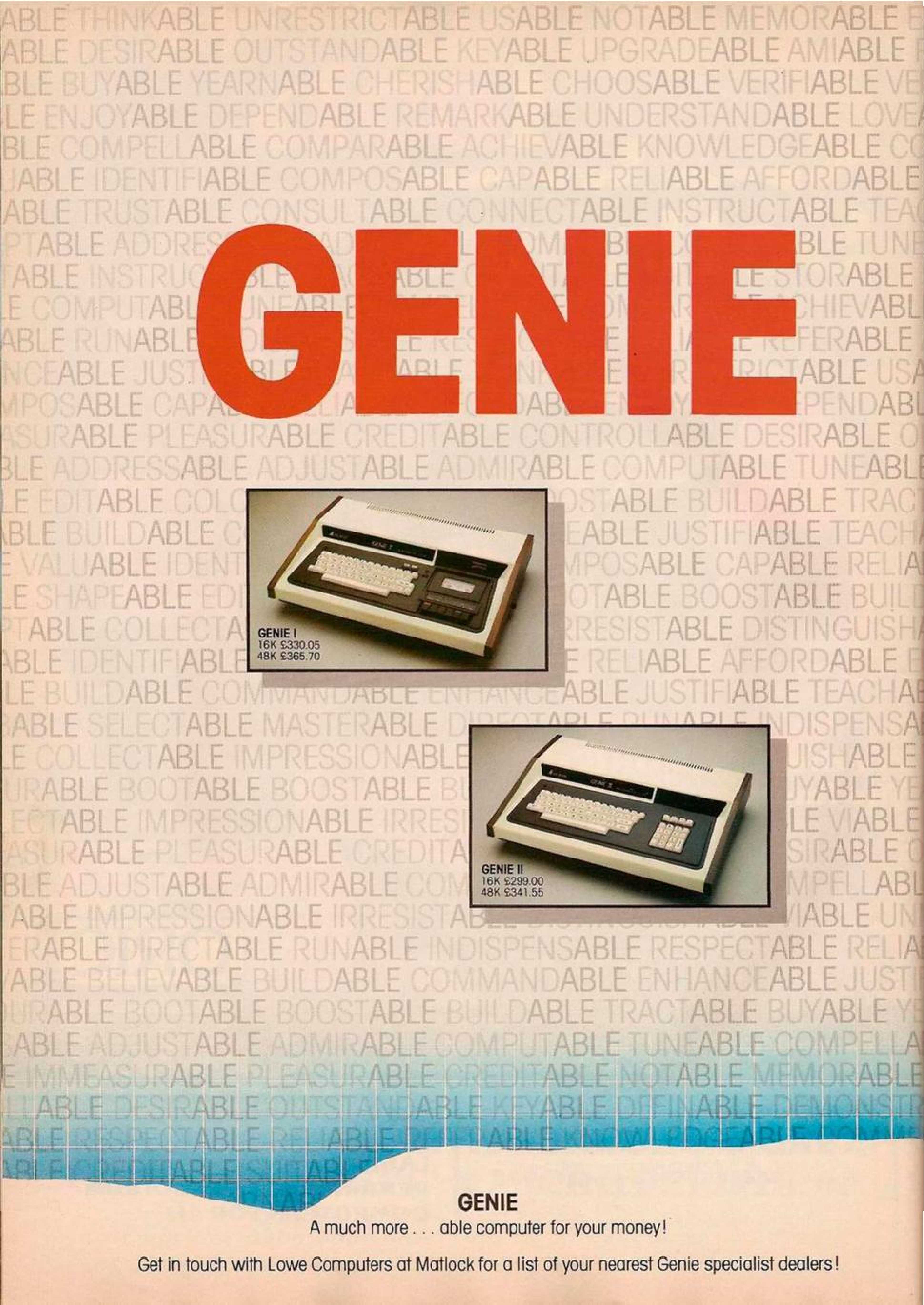
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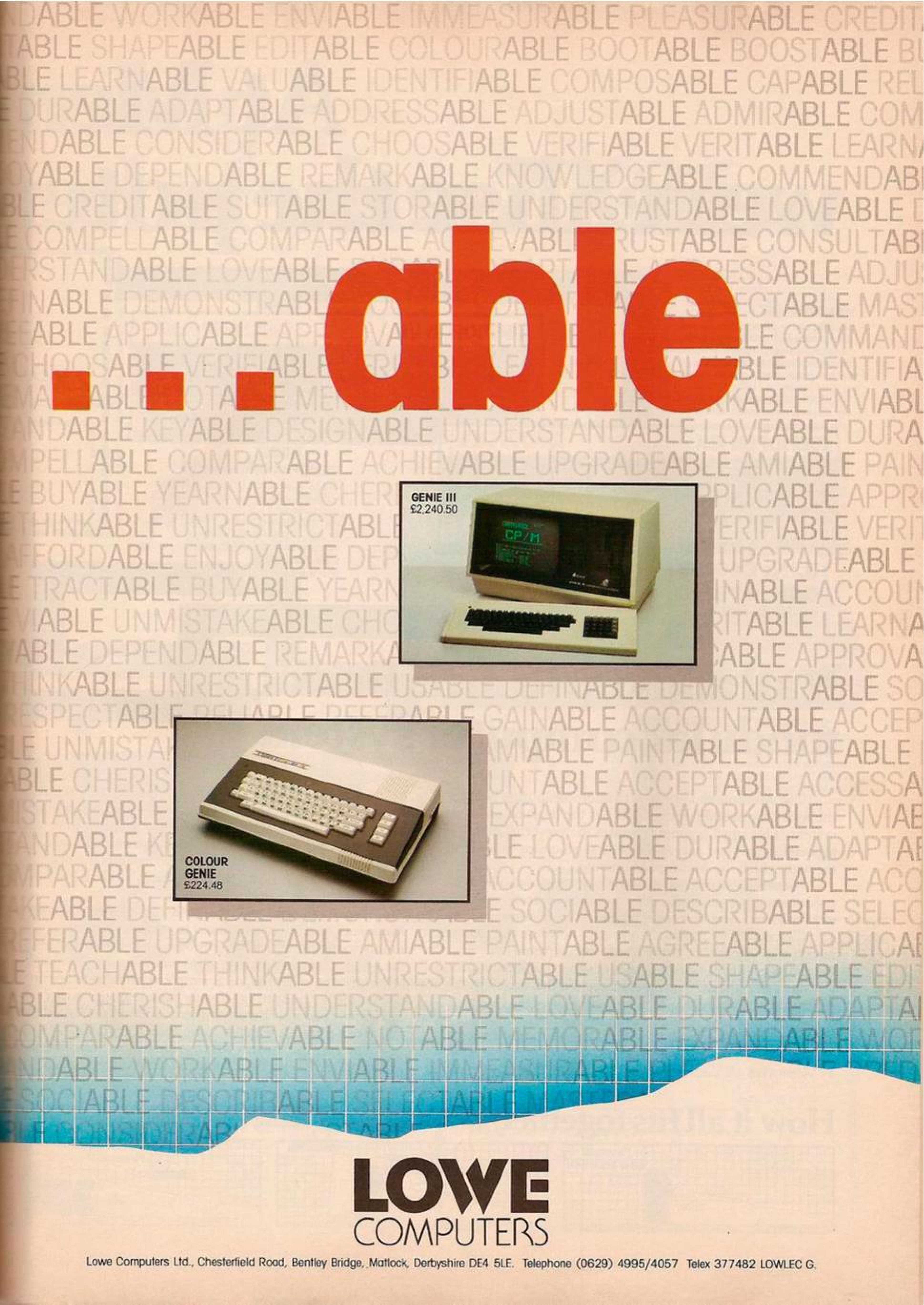
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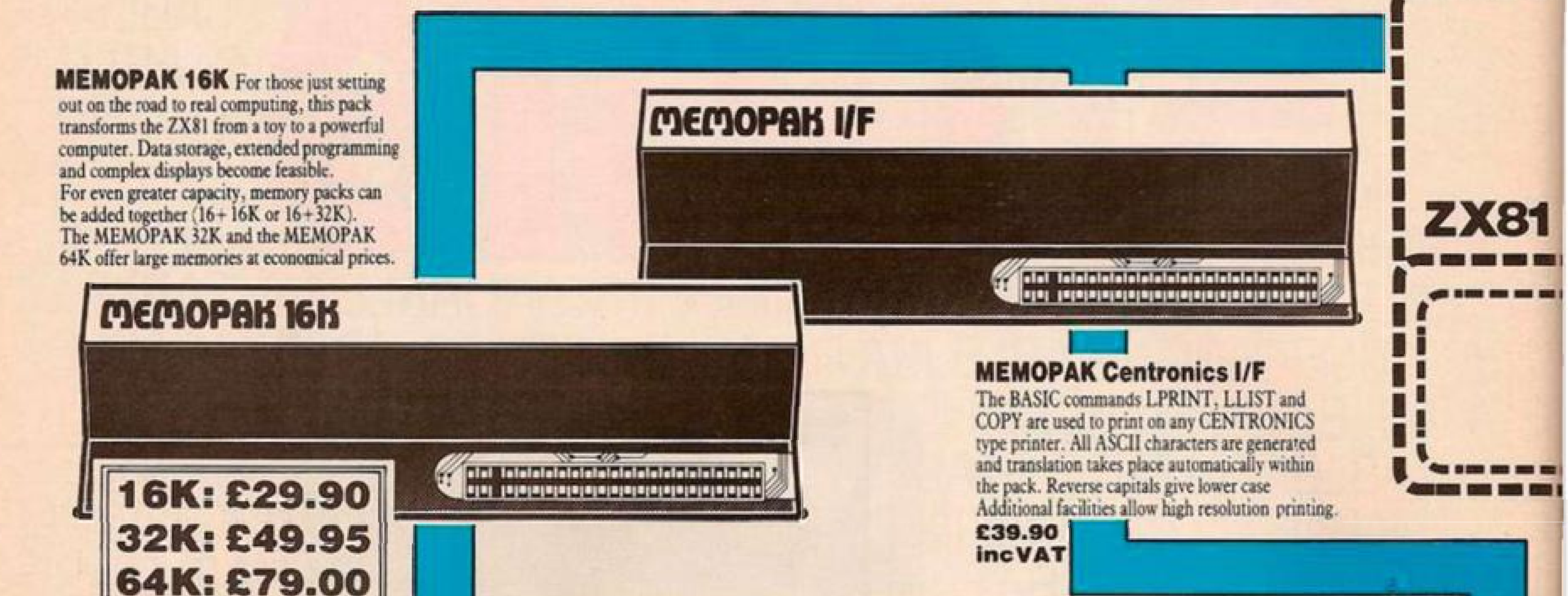
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It all adds up to an efficient, modular computer system

The **Memotech** approach to microcomputing is to take the well-proven and popular ZX81 as the heart of a modular system. This small computer houses the powerful Z80A processing unit and acts as the central processor module through which the **Memopaks** operate.

Memotech has a reputation for professional quality, producing units which are designed to fit perfectly, to look well-balanced, and to work efficiently and reliably.

The modular approach gives ZX81 owners the freedom to design the system they really need. Furthermore, the intercompatibility of the modules ensures that later additions will click straight in, to give you a system that grows with your ambitions and abilities.

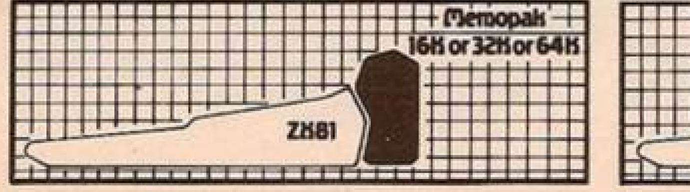
To ensure that your expectations are realised, care is taken at every stage to design features into the system to anticipate your needs. For example:
1) Memories are cumulative e.g. 16K and 32K can be added to the **Memopak 16K** or even to the Sinclair 16K RAM pac **2**) The **HRG** firmware allows commonly used constructions (such as scrolling, shading and labelling graphs), to be calle by a few simple commands. **3**) The **Centronics I/F** converts ZX81 character codes into ASCII and extends the print line the width of the printer, still using the LLIST, LPRINT an COPY commands.

As one example, a system with 16K of memory and **Memocalc** is all that is required to perform the same sophisticated numerical projections as a computer at 10 tim the price. The problem may be as complicated as a cash flo or production schedule, or as simple as household accounts pocket money budgeting. If your bank manager wants to se cash flow, then a single print instruction to the **Centronics** will give a printout which is more than acceptable.

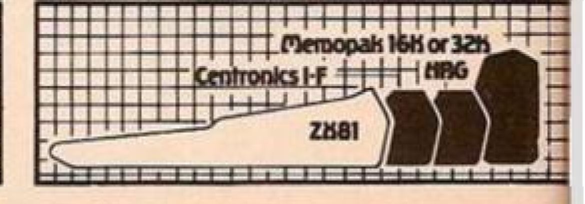
The example system which is shown, on the other han would satisfy the needs of someone who wanted to enter da

How it all fits together

You can see from the diagrams how various Memotech/Sinclair units can be combined.







otech,
tial of your ZX81...



ia a light-touch keyboard, construct and label graphs, and hen copy the screen to an 80-column printer. Only 16K of emory is shown here but with additional memory, more than ne video page can be stored. Up to 7 pages can be displayed n rapid succession to give animated displays.

Looking forward, **Memotech** will continue to back the ZX81 through 1983 with fast storage devices, pressure sensitive ectronic drawing boards and more software packs including a **ordprocessor**, an **RS232 Interface** and a **Z80 Assembler**.

MEMOTECH products are available from major ranches of W.H. SMITH'S & JOHN MENZIES

Software for SPECTRUM: DRAGON: ZX 81: and Now ATARI and TANDY



M.C. LOTHLORIEN



JAPANESE CHALLENGE TO SPECTRUM AND TANDY OWNERS

5 ferocious, medieval Japanese **Warlords** and pirate bands who have been successfully invading **Dragon** and **ZX 81** homes, are now poised to attack the homes of **Spectrum** and **Tandy** owners. Will you be able to resist this challenge? To succeed you must marshall your forces of warriors and Samurai, build and maintain your merchant ships, safeguarding them from attack and plan your village's food supply. To survive you must defeat all your opponents by attacking them, resisting their attacks and making raids. See the results of your decisions on graphics map of Japan for pirate battles and other graphics for Samurai, army and personal combat. The price of failure is high. Order as **WARLORD.**
Availability DRAGON 32: SPECTRUM 48K: TANDY 32K COLOR COMPUTER: ZX 81 16K (Note ZX 81 omits some of the above features and does not include graphics)

ROMAN EMPIRE

Yes **Atari, Tandy** and **Dragon** owners can now discover the challenge offered by our largest selling **Spectrum** game in which you are Emperor of Rome and must attempt to manoeuvre your legions and armies to subdue the provinces of the Empire. A test of your generalship with **3 Levels of play** and variable starting strengths for your opponents.
Atari, Dragon and **Tandy** versions feature **colour graphic maps** and supporting graphics for battle results. **Spectrum** version uses User Defined Graphics.
Availability ATARI 800 and ATARI 400 (48K extended): TANDY 32K COLOR COMPUTER: DRAGON 32: SPECTRUM 16K: ZX 81 16K

Not a wargame but a 3 phase real time game which gives you command on a Royal Navy ship at the time of Nelson. Your mission is to intercept **French Privateers** who are operating in the Baltic and the 1st phase requires you to lay the elevation and fuse for your mortar to **knock out a shore battery.** Phase 2 allows you to sail your ship (using arrow keys) to **intercept** the **Privateers.** If you succeed then you pass to phase 3 where the keys 1-9 will **fire your guns.** Be careful he doesn't escape at this late point or, worse still sink you.
5 Privateers to be intercepted each game, your continued service and promotion in the Navy are dependent on your success.
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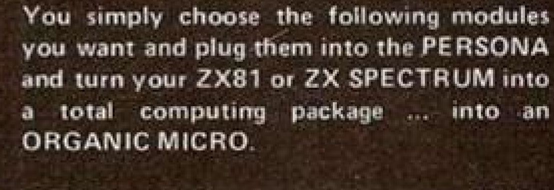
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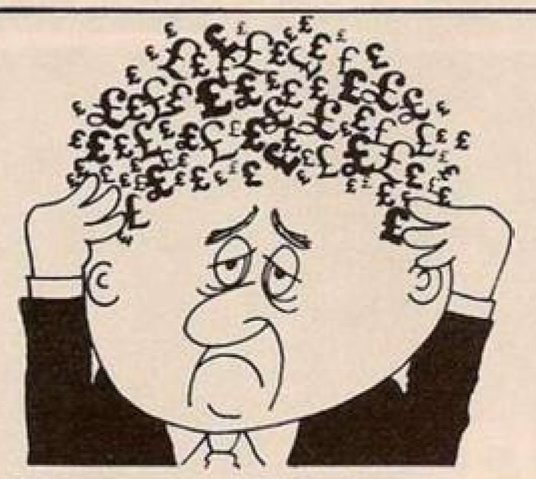
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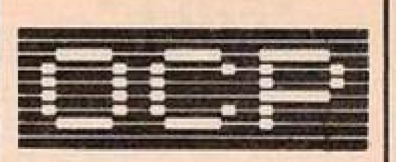
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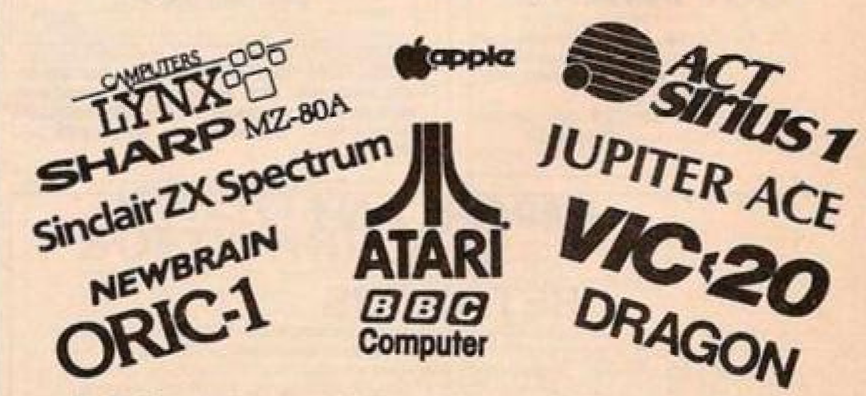
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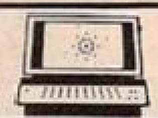
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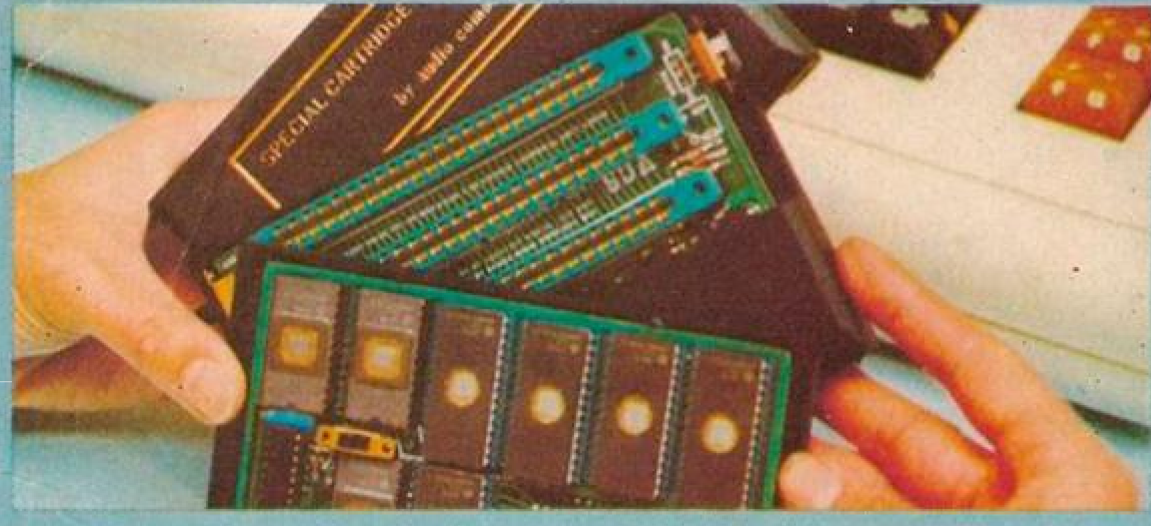
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THE INTEGRAL EXPANSION SYSTEM FOR VIC 20



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The *Sinclair Ram Pack* is attached to the computer by a small contact area, as shown in figure 1.
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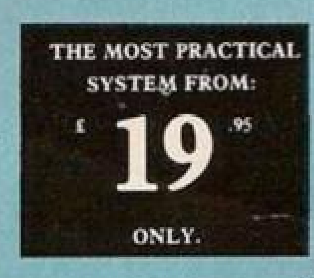

Fig. 1


Fig. 2

IF YOU'RE LOOKING FOR A 16K RAM PACK,



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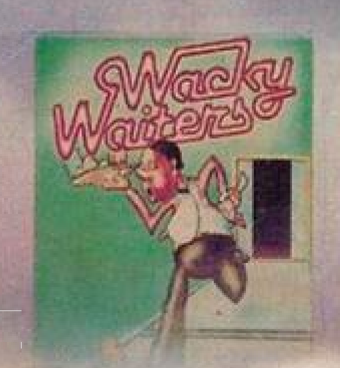
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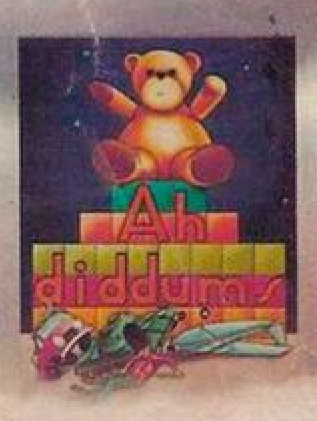
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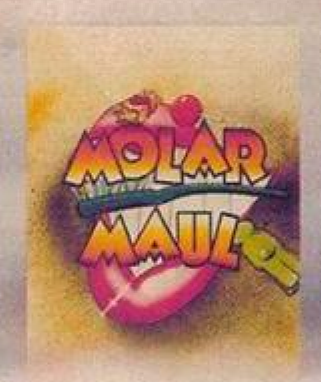





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